

**INSTRUCTION MANUAL
FOR
MODEL TTS 66
TELEPHONE REPAIR TEST SET**



NORTHEAST ELECTRONICS CORPORATION

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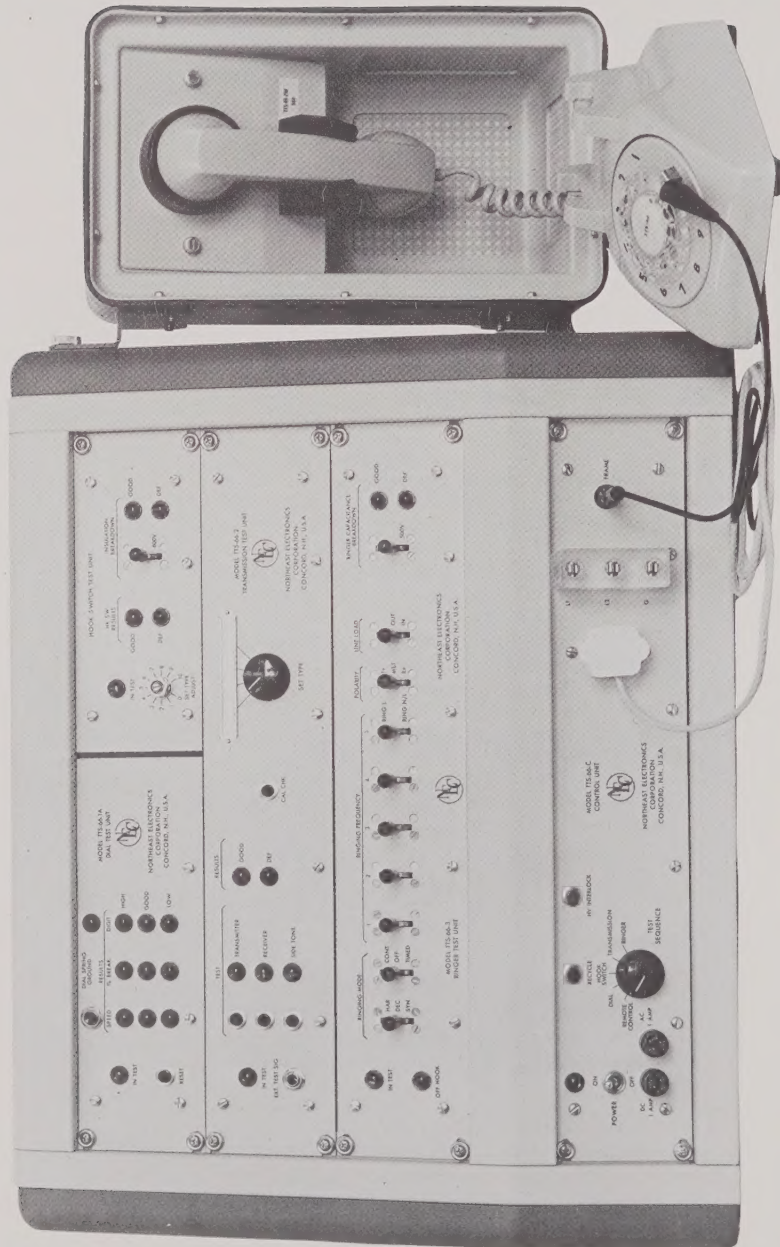
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TTS 66 TELEPHONE REPAIR SET

SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL. The Model TTS 66 Telephone Repair Test Set is a bench mounted unit designed for use in telephone repair centers to perform all of the tests necessary to evaluate the performance of subscriber telephone sets.

1.2 Colored lamps on the sloping front panel indicate the results of the individual tests on a go-no-go basis, eliminating the time consuming interpretation of meter readings.

1.3 A foot operated switch allows the user to cycle through the various tests, repeat tests, and reset the indicator lamps, thus leaving the hands free to perform adjustments on faulty telephones and to replace components.

1.4 The TTS 66 is composed of a Control Unit (TTS 66-C) and three other modules, each performing a group of tests on a particular section of the telephone set. Each of these modules, with a Control Unit, can be

supplied in a separate cabinet for "production line" type processing of telephone sets if desired.

1.5 The different modules are:

TTS 66-C Control Unit
TTS 66-1A Dial Test Unit with Hook-switch Test Unit
TTS 66-2 Transmission Test Unit
TTS 66-3 and TTS 66-3A Ringer Test Unit

1.6 Refer to the individual manuals on each module for the description and specifications and all other pertinent information.

1.7 ACCESSORIES. The accessories supplied with the TTS 66 are:

TTS 66-2AC - Acoustical chamber
TTS 66 Rear Panel - For interconnection of the modules.
TTS 66XPS - Optional power supply

NOTE

The TTS 66, when used with a TTS 66XPS Power Supply, may be operated on 110-120 Volts ac, 50-60 Hz.



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SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS - each of the individual manuals on the separate modules contains a detailed description of the front panel controls.

2.2 PRELIMINARY PROCEDURE. Connect -48V dc to the jack on the rear panel (Fig. 2-1). If the test set contains the optional TTS 66XPS Power Supply, connect the power cord furnished between the connector and a source of 110-120V ac, 50-60 Hz. On the TTS 66C Control Unit, set the POWER switch to ON.

NOTE

The low voltage power supply contained in the TTS 66C requires a warm-up period of approximately 5 minutes before measurements or calibration procedures can be performed.

2.3 Connect the acoustic chamber and foot switch to the rear of the test set. The chamber may be mounted on either side of the console.

2.4 The following checks may be made with or without a telephone set connected to the TTS 66-C Control Unit; this provides a quick check of the overall operation of the test set. (See table below)

2.5 Set the TEST SEQUENCE switch to REMOTE CONTROL.

NOTE

If the foot switch is used, the TEST SEQUENCE switch will have to be cycled through the different positions as each test is made.

2.6 Connect the telephone set cord to the L1, L2 and G terminals on the TTS 66C. Connect the FRAME terminal to the finger stop on the dial using the test lead furnished with the unit.

2.7 DIAL TESTING

a. Remove the handset from its cradle but do not insert it in the acoustic chamber.

b. Depress the right-hand foot switch and note that the DIAL SPRING GROUND lamp does not operate, thus indicating the absence of a ground on the dial spring.

c. Depress the right-hand footswitch Dial 0 (zero) on the telephone under test; the RESULTS lamps will operate indicating the SPEED, % BRK and DIGIT. This test may be repeated by de-

CONTROL	ACTION	RESULT
1. TEST SEQUENCE switch	Cycle through all positions.	Observe that the respective IN TEST lamps operate.
2. TEST SEQUENCE	Set to TRANSMISSION.	
3. CAL CHK pushbutton	Depress & hold.	Observe that the RESULTS GOOD lamp operates.

Section 2

Paragraphs 2.7 to 2.11

2.8 HOOKSWITCH TESTS

- a. Depress right-hand foot switch and note that the IN TEST lamp lights.
- b. Place the telephone in the on hook position, the HK SW RESULTS DEF lamp should operate.
- c. Slowly release the hookswitch on the telephone. If the hookswitch sequence is correct, the HK SW RESULTS GOOD lamp should operate.
- d. Replace the telephone on hook; the HK SW DEF lamp should operate.
- e. Repeat step b and observe the results.
- f. Operate the INSULATION BREAKDOWN key to 600V and simultaneously depress the HV INTERLOCK pushbutton on the TTS 66-C front panel. The INSULATION BREAKDOWN GOOD or DEF lamp will operate to indicate satisfactory or defective insulation.

2.9 TRANSMISSION TESTS

NOTE

Before any telephone set may be tested, the TTS 66 Telephone Test Set must be normalized to accept the four types of telephone sets to be tested. The normalization procedure requires that a reference subscriber set (having "average" transmission responses for its particular type) is available for each type to be tested. Section 4 of the TTS 66-2 manual contains a method for the statistical determination of a reference set.

- a. Depress right-hand foot switch and note that the IN TEST lamp and TRANSMITTER lamp lights.
- b. Turn the SET TYPE control to the correct positions for the type of telephone to be tested.

- c. Condition the transmitter of the telephone set by rotating the handset in an arc of 180° both CW and CCW. Place the handset in the acoustic chamber with the earpiece FIRMLY PUSHED IN ALL THE WAY into the cup and the handle firmly in the saddle grip.

NOTE

Perform all transmission tests involving this handset within 30 seconds after conditioning the transmitter or repeat the entire test.

- d. Note by the operation of the RESULTS GOOD or DEF lamps the condition of the transmitter.
- e. Depress the right-hand foot switch and release. The TEST RECEIVER lamp will operate. Note by the operation of one of the RESULTS GOOD or DEF lamps the condition of the receiver.
- f. Depress the right-hand foot switch and release. The TEST SIDETONE lamp will operate. Note by the operation of one of the RESULTS GOOD or DEF lamps the condition with regard to sidetone.

NOTE

Ensure that not more than 30 seconds has elapsed for steps d through f or else repeat the steps.

2.10 RINGER TEST. Operate right-hand foot switch and observe that the IN TEST lamp lights on the Ringer Test unit.

- 2.11 a. If harmonic, decimonic or synchmonic ringing is used, establish the proper condition with the RINGING MODE keys. Ringing is obtained either continuously or timed by the operation of the CONT-TIMED key. The desired ringing polarity, on tip, ring or metallic, should be established by the POLARITY key. The LINE LOAD key in-

troduces or removes a line load condition of 1200Ω and leak A network.

b. The ringing tests are on an audible basis. Operate required RINGING FREQUENCY key to RING L or RING N/L (locked or not locked).

c. At the completion of the ringing tests, operate the RINGER CAPACITANCE BREAKDOWN key to 500V

while simultaneously depressing the HV INTERLOCK pushbutton on the TTS 66C front panel.

2.12 A satisfactory or unsatisfactory condition is indicated by the associated GOOD or DEF lamps. With the above, if a handset is placed off hook, the OFF HOOK lamp will light precluding further test until handset is placed on hook.

SECTION 3

CIRCUIT DESCRIPTION

SECTION 4

CALIBRATION AND MAINTENANCE

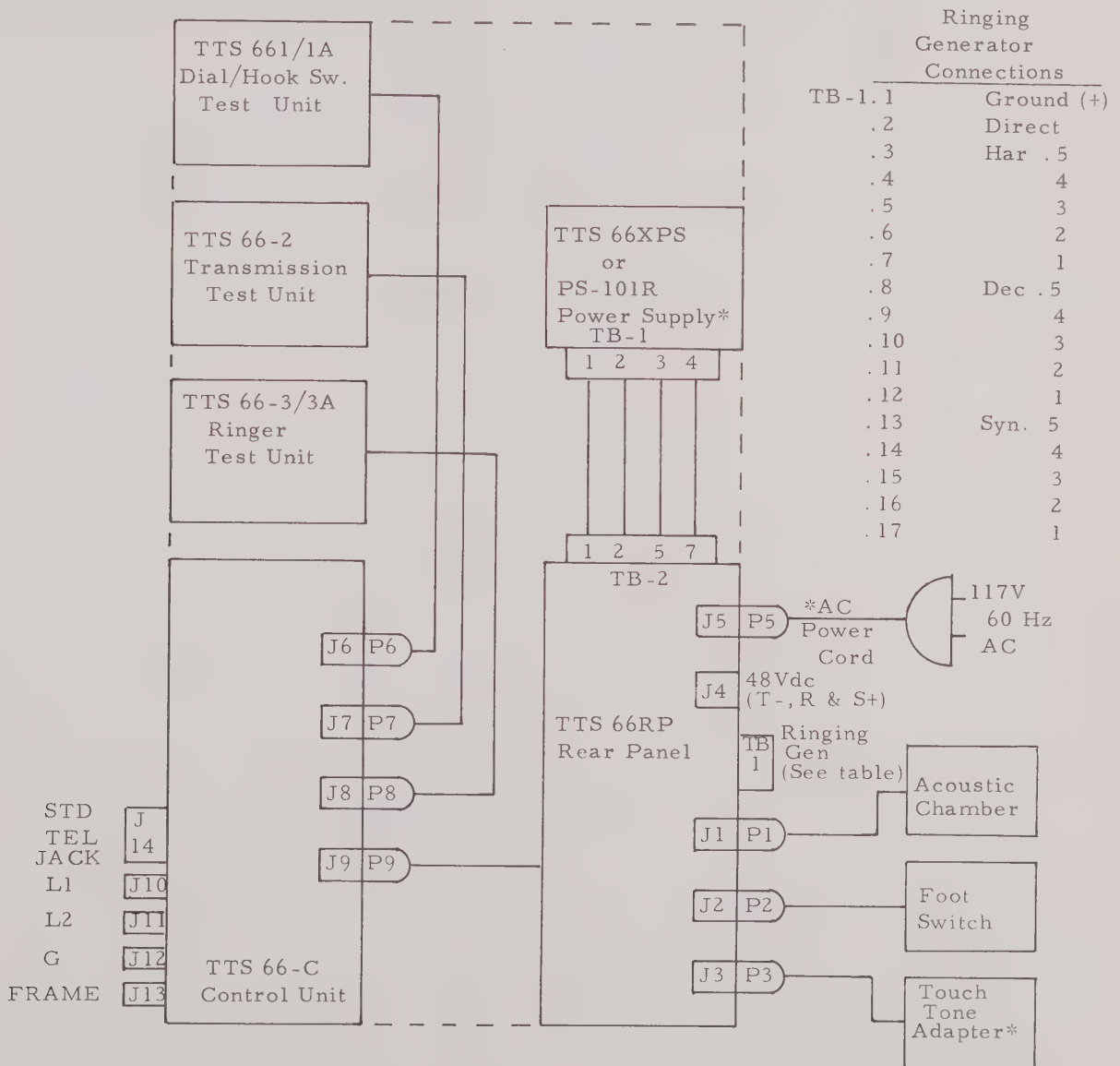
NOTE

Refer to the individual instruction manuals for circuit description and calibration and maintenance instructions.

SECTION 5

SCHEMATIC DIAGRAMS

5.1 INTRODUCTION. The following pages contain the schematic diagrams for the TTS 66. Wherever possible all the information is contained on one diagram, however, because of limitation in printing some of the individual printed circuit boards are illustrated on separate sheets.



*Optional

Fig. 5-1 TTS 66 Interconnection Diagram

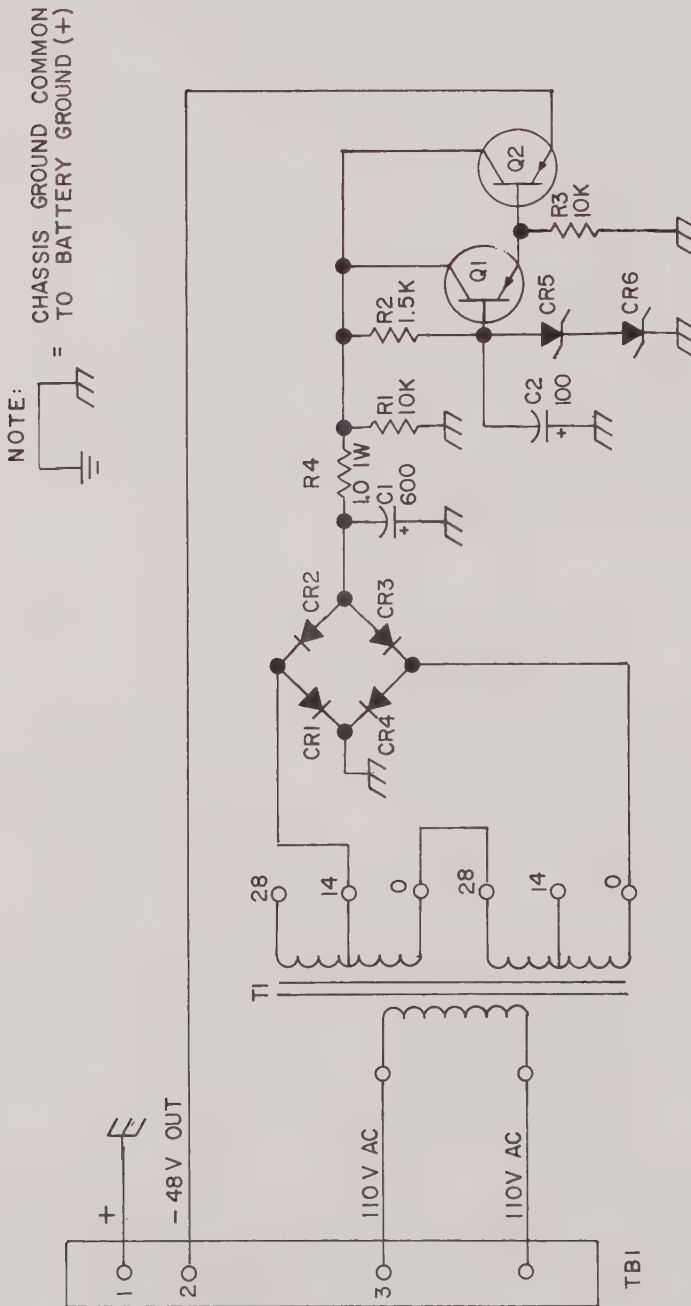


Fig. 5-2 TTS 66XPS Schematic Diagram

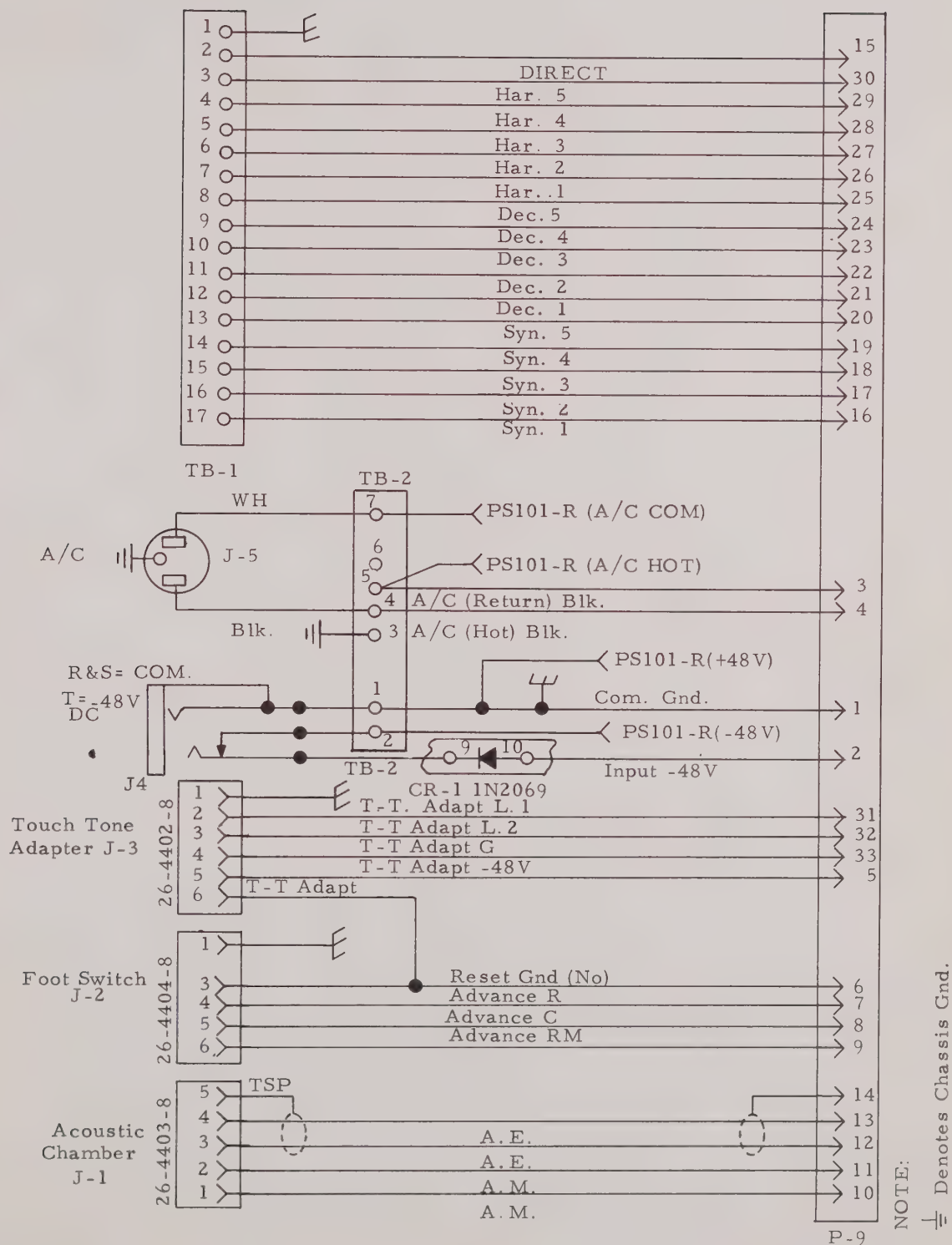


Fig. 5-3 TTS 66 Rear Panel

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 66.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of these codes and their respective manufacturers is given below.

LIST OF MANUFACTURERS

Code No.	Manufacturer
01121	Allen Bradley
01295	Texas Instruments
06819	NEC
10013	Cornell-Dublier
12143	Bendix
13606	Sprague
15873	Motorola
80368	Sylvania
81095	Triad
97918	Linemaster Switch Corp.

TTS 66 - Parts List

Description	Manufacturer	Part No.
Control Unit	06819	TTS 66-C
Dial Test Unit with	06819	TTS 66-1A
Hookswitch Test Unit		
Transmission Test Unit	06819	TTS 66-2
Ringer Test Unit (15 frequency)	06819	TTS 66-3
Ringer Test Unit (single frequency)	06819	TTS 66-3A
Rear Panel	06819	TTS 66RP
Acoustic Chamber	06819	TTS 66-2AC
Power Supply	06819	TTS 66XPS
Foot Switch (2)	97918	T-51-S

Circuit Ref.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd elect 200 μ F 150V	10013	BR-200-150
C1A	C: fxd elect 200 μ F 150V	10013	BR-200-150
C1B	C: fxd elect 200 μ F 150V	10013	BR-200-150
C2	C: fxd elect 100 μ F 50V	13606	TVA 1310.
R1	R: fxd comp 10K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R2	R: fxd comp 1.5K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R3	R: fxd comp 10K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R4	R: fxd comp 1 Ω $\pm 5\%$ 1W	13606	239E1R05
Q1	Transistor: PNP	01295	2N1575 2N4354 = AIRCH 1112
Q2	Transistor: Power, PNP	12143	2N1136A
CR1 thru CR4	Diodes: silicon	80368	1N2069
CR5 and CR6	Diodes: zener 24V $\pm 10\%$	15873	1N3029B
T1	Transformer: step-down	81095	56-1

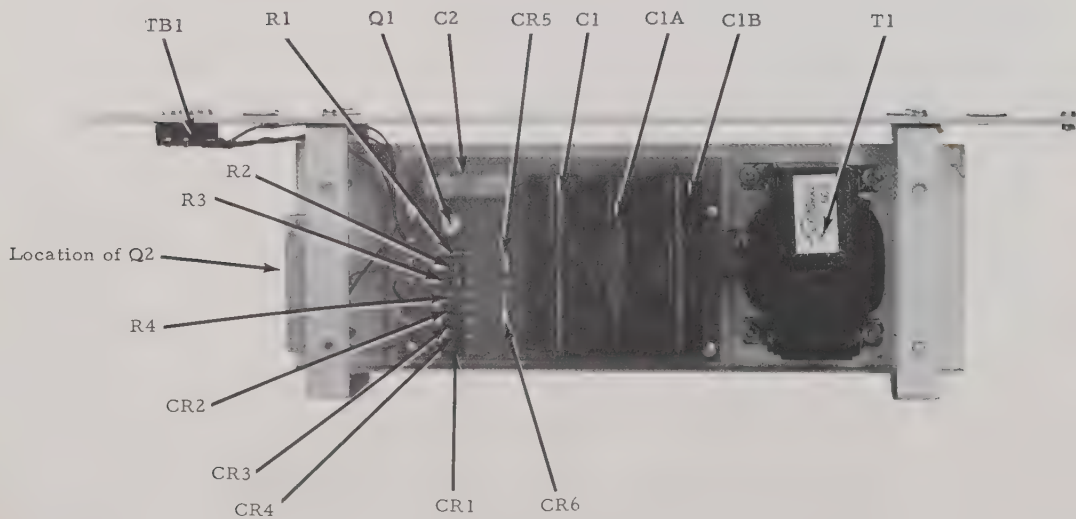


Figure 6-1 TTS 66XPS Power Supply

**INSTRUCTION MANUAL
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CONTROL UNIT**



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SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL. The TTS 66C Control Unit provides the basic control function for the TTS 66 system or for each of the specific modules of the system when used separately. The unit allows manual or remote control operation.

1.2 The unit contains the power switch, line fuse and the terminals for connection of the telephone set under test.

1.3 SPECIFICATIONS

LOW VOLTAGE POWER SUPPLY

Output Power: 24V dc $\pm 10\%$ @
500mA.

HIGH VOLTAGE POWER SUPPLY

Output Power: 500V & 600V dc
 $\pm 10\%$ @ 10 mA.

HIGH VOLTAGE BREAKDOWN DETECTOR:

Threshold Current: 12.5 μ A

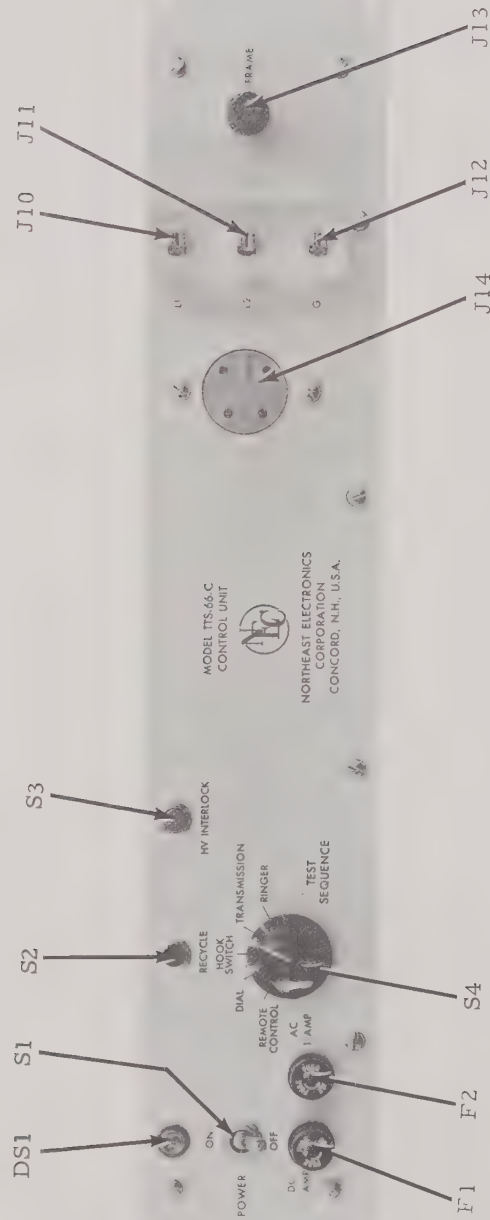


Figure 2-1 Front Panel Controls

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS

Name of Control	Ref Desig.	Type of Control	Use or Purpose
POWER lamp	DS1	Indicator	Indicates power on or off.
POWER switch	S1	Toggle switch	Controls ac and dc power to set.
TEST SEQUENCE switch	S4	5-position rotary switch	For manual or remote selection of test sequence.
RECYCLE pushbutton	S2	Pushbutton switch	Used when in REMOTE mode to return RM stepping switch to home position.
HV INTERLOCK pushbutton	S3	Pushbutton switch	Used for protection when high voltages are used - must be used in conjunction with INSULATION BREAKDOWN or CAPACITANCE BREAKDOWN switches.
	J14	Standard telephone jack.	To connect telephone to be tested.
L1, L2 & G	J10, J11, J12	Spring clip	Protected terminals for connection of telephone.
FRAME	J13	Spring loaded post	Provided for connection to telephone frame.

2.2 OPERATING INSTRUCTIONS. There are no specific operating instructions for the TTS 66-C Control Unit. Refer to the

manuals on the TTS 66-1A, TTS 66-2 and TTS 66-3 for its uses.

SECTION 3

CIRCUIT DESCRIPTION

3.1 The TTS 66-C contains the Power Supply (24V dc), the H. V. Supply (500 & 600V dc), the HV Breakdown Detector and means of switching these circuits to the unit under test.

3.2 All units are connected to the rear panel of the TTS 66-C. A rotary switch is used for the manual mode of operation or a stepping switch with external foot switch is used for REMOTE CONTROL. These switches control all power and the input line connects

to the unit in test.

3.3 The HV INTERLOCK pushbutton switch is used during the insulation and capacitor breakdown test, in conjunction with the applicable key switches, to ensure that the operator's hands do not touch the telephone under test or the connection terminals when the high voltage is present. A switch for both AC and DC power is provided on the front panel.

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 CALIBRATION.

rear panel.

4.2 HIGH VOLTAGE BREAKDOWN DETECTOR-THRESHOLD ADJUST-R3. If this adjustment is required, follow instruction on the schematic diagram, Fig. 5-2.

4.3 HV BREAKDOWN RESISTANCE ADJUST-INSUL-R2. This control is factory set for a low limit of $48M\Omega$. Rotating the control clockwise will raise this low limit. (See Fig. 6-1).

4.4 HV BREAKDOWN RESISTANCE ADJUST-RGR CAP-R4. This control is factory set for approximately $40M\Omega$. Turning in a clockwise direction will raise this value. (See Fig. 6-1).

4.5 MAINTENANCE INSTRUCTIONS. In the event of a malfunction in the operation of the set, the following simple checks should be performed before attempting more detailed trouble-shooting.

a. Check to see that the power connection on the rear panel is correctly connected to the proper external power source:

1. DC (office battery):
44-52V dc, tip negative,
ring or sleeve positive:

or

2. AC (for use only when equipped with TTS 66XPS or PS101R regulated 48V dc power supply): 115V ac 60 Hz.

b. Check that all fuses are installed and are of the specified type and rating.

c. Check that all interconnecting plugs are fully mated with the correct receptacles on the rear of the TTS 66-C Control Unit and

4.6 If the malfunction is not cleared during the previous steps, proceed as follows with the POWER switch in the OFF position.

a. Completely remove the affected unit from the console by removing the four front panel screws and carefully sliding the unit forward and out. The interconnecting cable will be long enough to allow the unit to be placed on the bench adjacent to the console without disengaging.

b. To gain access to the plug-in component boards, remove the two screws in the upper corners of the hinged rear chassis plate and allow it to swing down. The cards should be removed with the extractor key pulling straight back until the guides are cleared.

c. Perform a visual inspection of the unit looking for broken or shorted wires, damaged components and other obvious faults.

d. Check that all plug-in boards are in their correct locations and are fully engaged.

e. Check that all plug-in components (including lamps) are fully engaged in their respective sockets.

f. Check operation of panel switches, noting that they operate freely. Visually inspect contacts to ensure positive electrical connections. If required, clean contacts with a good contact cleaner.

4.7 DC POWER DISTRIBUTION

a. Unless otherwise indicated all voltages are referred to "ground". Connect

Section 4

Paragraph 4.7

tions to ground can always be made to either pin #1 on all interconnecting plugs and sockets or pin A of plug-in component cards.

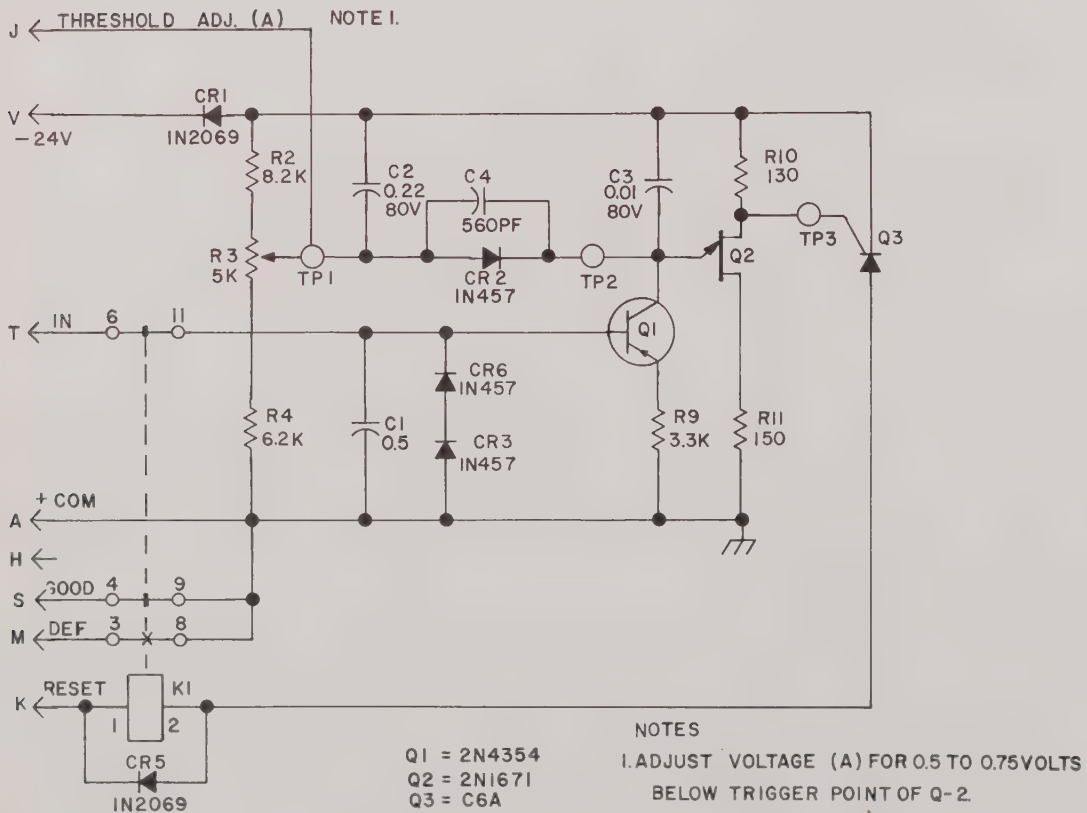
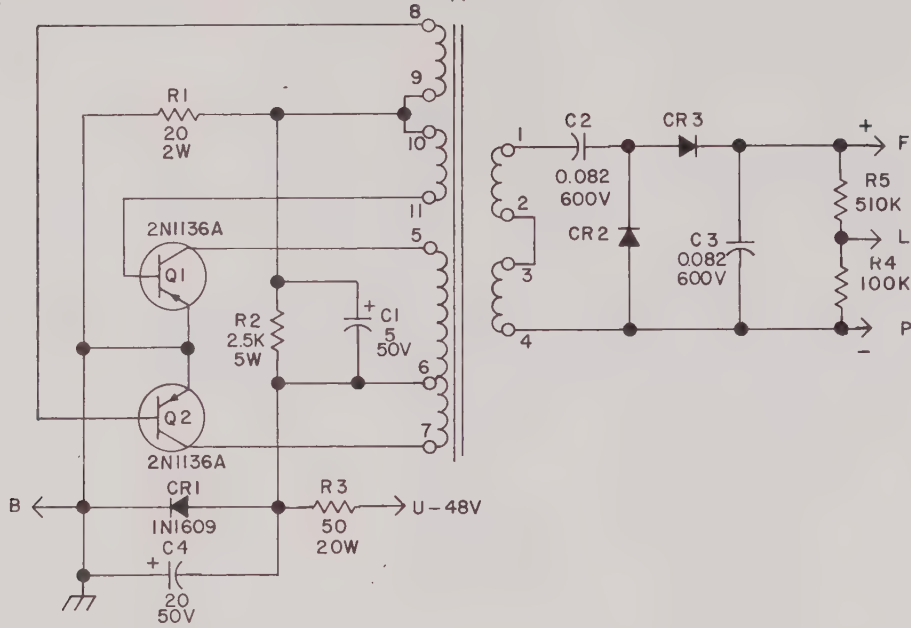
b. With POWER switch set to ON, select the desired test and measure the appropriate dc voltages in accordance with the table below.

UNIT	TEST SELECTED	CONTROL OPERATED	-44 to -52Vdc		-22 to -25Vdc	
			Card or Plug	Pin #	Card or Plug	Pin #
TTS 66-C	REMOTE	RECYCLE	1	U	1	V
TTS 66-1A	DIAL	NONE	P-6	4	P-6	3
TTS 66-1A	HOOKSWITCH	NONE	P-6	12	P-6	11
TTS 66-1A	HOOKSWITCH	HV INTERLOCK	P-6	17	-	-
TTS 66-2	TRANSMISSION	NONE	P-7	2	P-7	3
TTS 66-2	TRANSMISSION	TRANSMITTER	P-7	5	-	-
TTS 66-2	TRANSMISSION	RECEIVER	P-7	6	-	-
TTS 66-2	TRANSMISSION	SIDE TONE	P-7	7	-	-
TTS 66-3	RINGER	NONE	P-8	2	-	-
TTS 66-3	RINGER	HV INTERLOCK	P-8	3	-	-

SECTION 5

SCHEMATIC DIAGRAMS

5.1 INTRODUCTION. The following pages contain the schematic diagrams for the TTS 66-C Control Unit. Wherever possible, all the information is contained on one diagram, however, because of limitations in printing some of the individual printed circuit boards are illustrated on separate sheets.



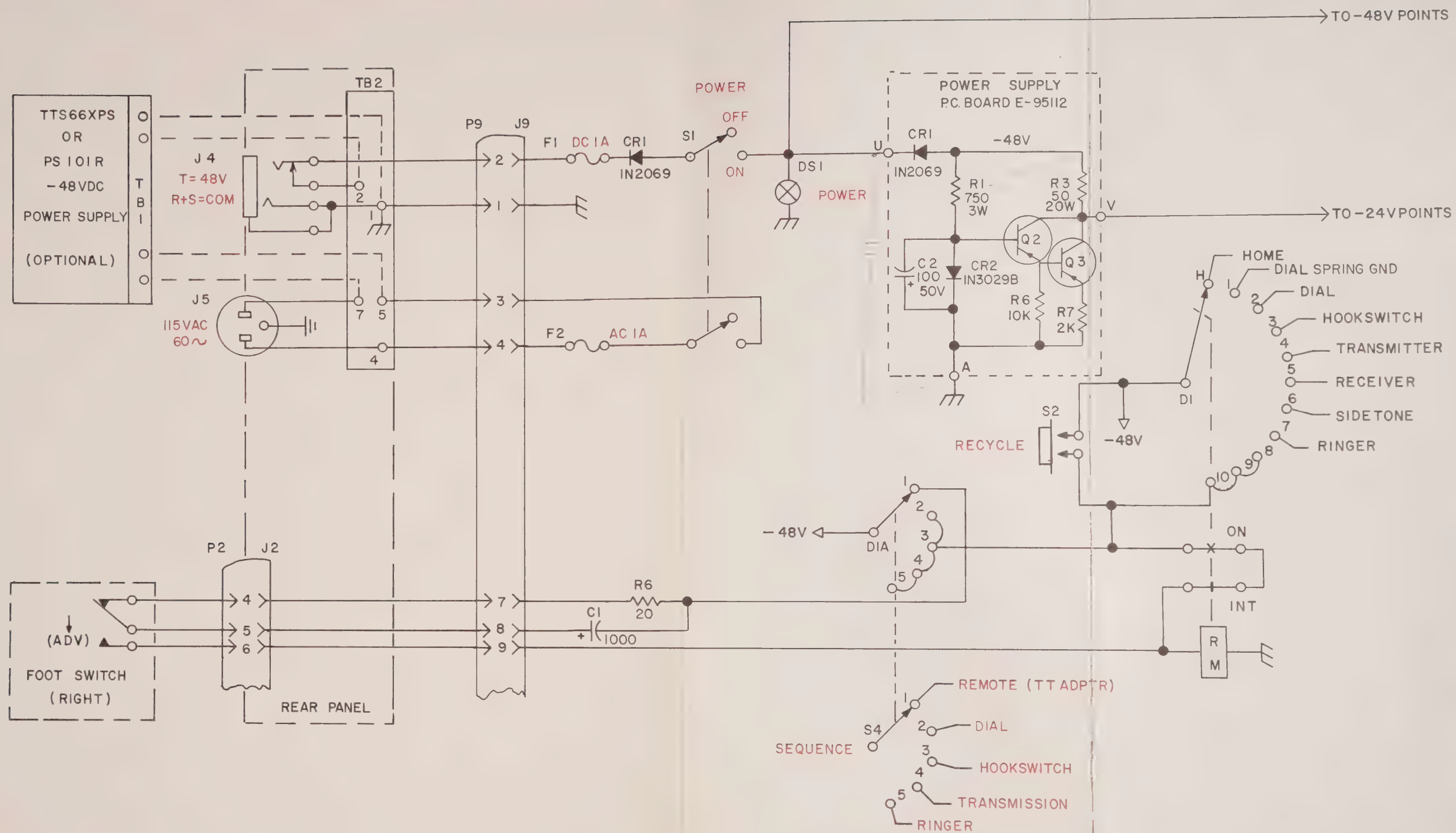


Figure 5-3 TTS 66-C Schematic Diagram
Power and Control Section

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 66-C.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of codes and their respective manufacturers is given below.

Code No.	Manufacturer
00656	Aerovox
01121	Allen Bradley
04009	Arrow-Hart & Hegeman
04221	Aemco
04773	Automatic Electric
06819	NEC
07015	Contact Inc.
07716	IRC
09653	IEI
10013	Cornell-Dublier
12143	Bendix
13606	Sprague
15873	Motorola
17803	Fairchild
24446	General Electric
44655	Ohmite
71590	CTS
75915	Littelfuse
80368	Sylvania
81095	Triad
82389	Switchcraft
84171	Arco
90201	Mallory
97918	Linemaster

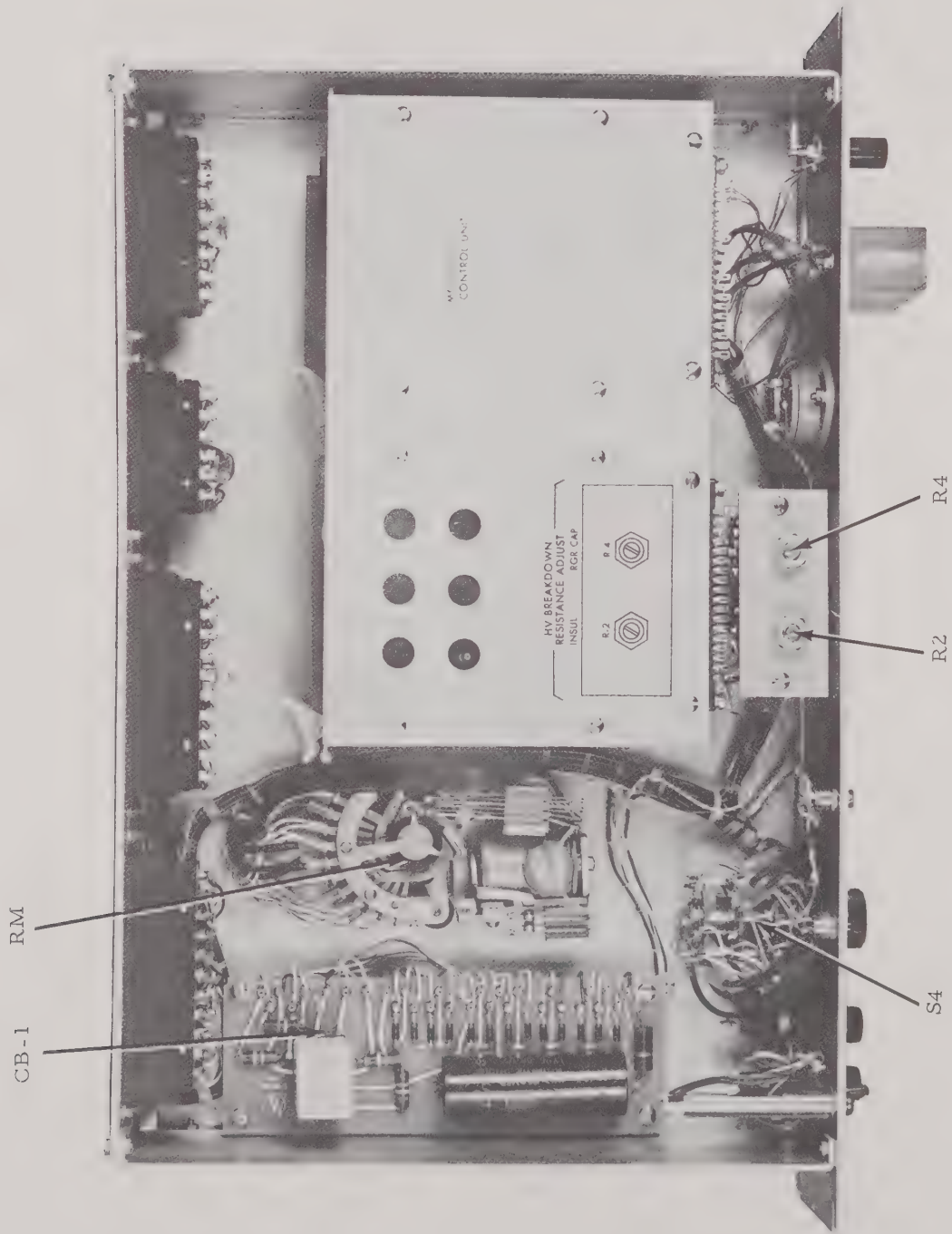


Figure 6-1 TTS 66-C Top View

Main Assembly

Circuit Ref.	Description	Manufacturer (FSCM Code #)	Part Number
R1	R: not used		
R2	R: var 50K		
R4	R: var 50K		
RM	S: stepping 6 level	04773	PW156115GAJC
S1	S: toggle DPDT	04009	81027-CH
S2	S: pushbutton S(blk)	82389	913
S3	S: pushbutton (red)	82389	903
S4	S: rotary 8 pol 5 pos	71590	PA022-2562
S5 and S6	S: 1C (part of FOOT SWITCH)	97918	T-51-5
J10 through J12	Test Clips	07015	DC-832
J13	Binding post: spring loaded (blk)	09653	29-33B
J14	Telephone jack	07716	548A-49
Card #1	Power Supply: complete (E95112)	06819	E95112
Card #2	H. V. Supply: complete (E95113)	06819	E95113
Card #3	H. V. Breakdown Detector: complete	06819	E95129
F1 and F2	Fuse: 1 amp	75915	AGC-1A

CB1

C1	C: fxd elect 1000 μ F 50V	10013	BR-100-50
R3	R: 100K $\pm$ 10% 1W		
R5	R: 100K $\pm$ 10% 1W		
R6	R: fxd comp 20 Ω $\pm$ 10% 2W	01121	
R7	R: 510K $\pm$ 10% 1W		
R8	R: 100K $\pm$ 10% 1W		
K1	Relay	04221	156-4023
CR1 to CR13	Diodes: silicon	80368	1N2069

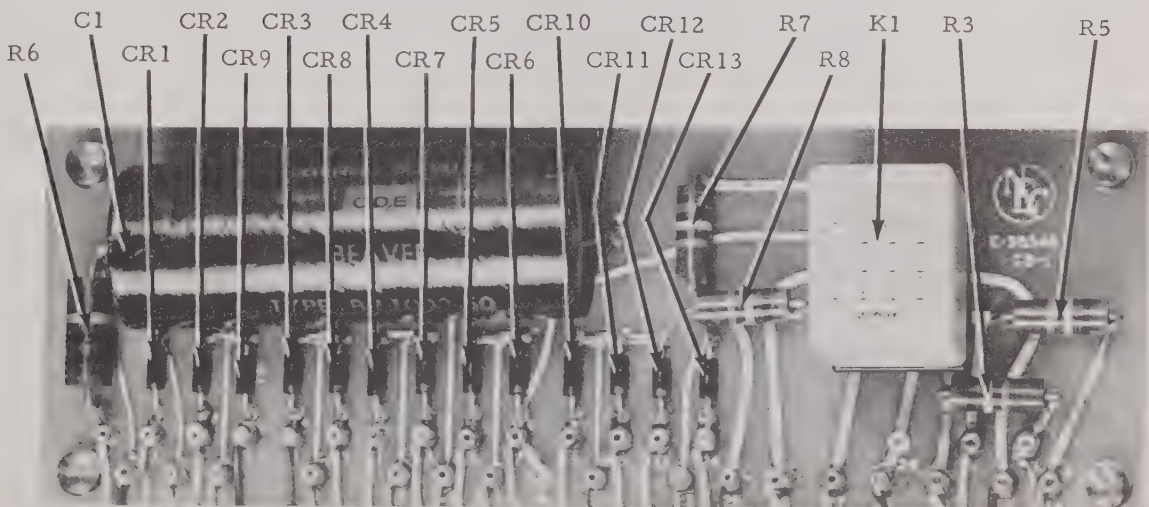


Figure 6-2 Component Location CB-1 E95348

Section 6

E95112 - Power Supply (Card #1)

Circuit Ref.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: not used on this board		
C2	C: fxd elect 100 μ F 50V	13606	TVA-1310
R1	R: fxd comp 750 Ω $\pm$ 5% 3W	44655	4418
R2	R: not used on this board		
R3	R: fxd comp 50 Ω $\pm$ 10% 20W	44655	1806
R4 and R5	R: not used on this board		
R6	R: fxd comp 10K $\pm$ 10% $\frac{1}{2}$ W	01121	
R7	R: fxd comp 2.0K $\pm$ 10% $\frac{1}{2}$ W	01121	
CR1	Diode: silicon	80368	1N2069
CR2	Diode: zener 24V $\pm$ 10%	15873	1N3029B
Q1	Transistor: not used on this board		
Q2	Transistor: PNP	17803	2N4354
Q3	Transistor: Power	12143	2N1136A

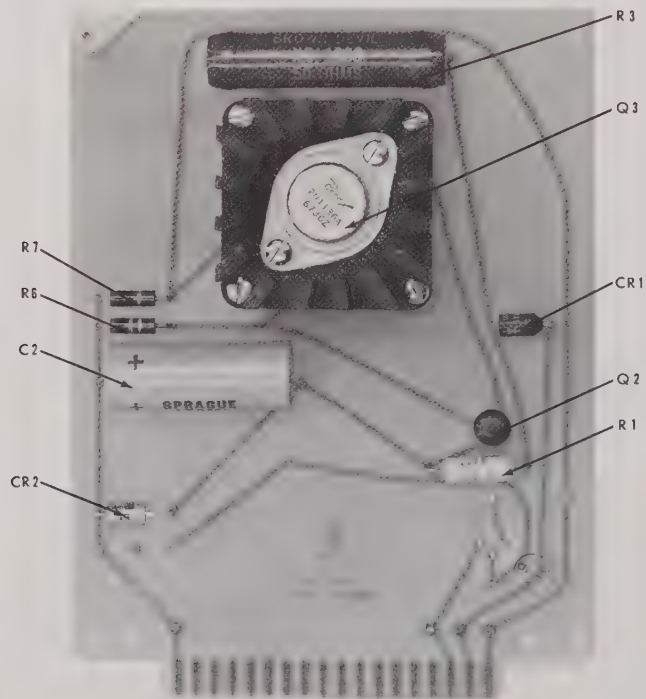


Fig. 6-3 Component Location - E95112

E-95113 - High Voltage Supply (Card #2)

Circuit Ref	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd elect $5\mu\text{F}$ 50V	13606	TVA 1303
C2 and C3	C: fxd 0.082 μF 600V	13606	
C4	C: fxd elect $20\mu\text{F}$ 50V	13606	TE-1305
R1	R: fxd comp 20Ω 2W	07716	
R2	R: fxd ww 2.5K $\pm 10\%$ 5W	13606	242E2525
R3	R: fxd ww 50Ω 20W	44655	1806
R4	R: fxd comp 100K $\pm 10\%$ 2W	01121	
R5	R: fxd comp 510K $\pm 10\%$ $\frac{1}{2}\text{W}$	01121	
Q1 and Q2	Transistor: Power	12143	2N1136A
CR1	Diode: zener	80368	1N1609
CR2 and CR3	Diode	80368	1N2071
T1	Transformer	81095	TY-89

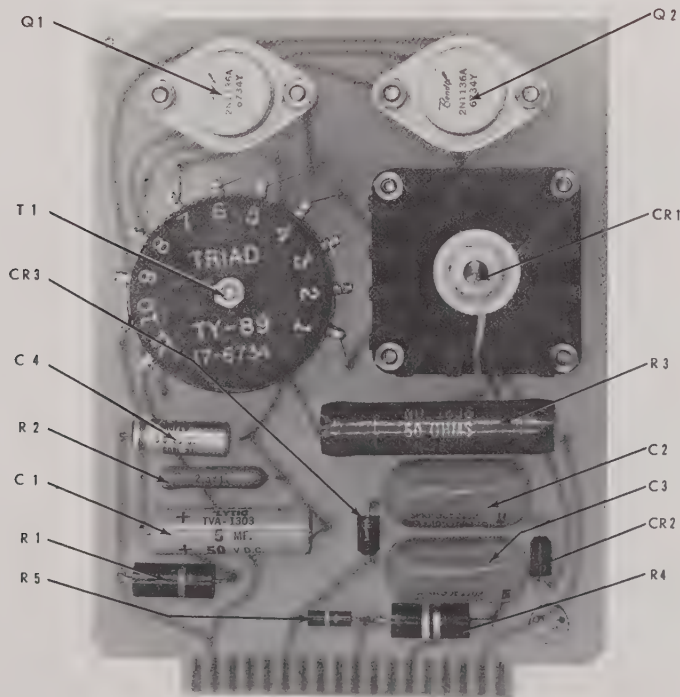


Fig. 6-4 Component Location - E95113

E95129 - H. V. Breakdown Detector (Card #3)

Circuit Ref.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd 0.5 μ F 200V	00656	P82922N1Z
C2	C: fxd 0.22 μ F 75V	13606	225P
C3	C: fxd 0.01 μ F 80V	13606	225P
C4	C: fxd 560pf	84171	CH15
R1	R: not used on this board		
R2	R: fxd comp 8.2K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R3	R: var comp 5K	90201	
R4	R: fxd comp 8.2K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R5 thru R8	R: not used on this board		
R9	R: fxd comp 3.3K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R10	R: fxd comp 130 Ω $\pm 10\%$ $\frac{1}{2}$ W	01121	
R11	R: fxd comp 150 Ω $\pm 10\%$ $\frac{1}{2}$ W	01121	
CR1	Diode: silicon	80368	1N2069
CR2 and CR3	Diode	80368	1N457
CR4	Diode: not used on this board		
CR5	Diode: silicon	80368	1N2069
CR6	Diode	80368	1N457
Q1	Transistor: PNP	17803	2N4354
Q2	Transistor: F.E.	17803	2N1671
Q3	SCR	24446	C6A
K1	Relay	04773	PD-13038-3

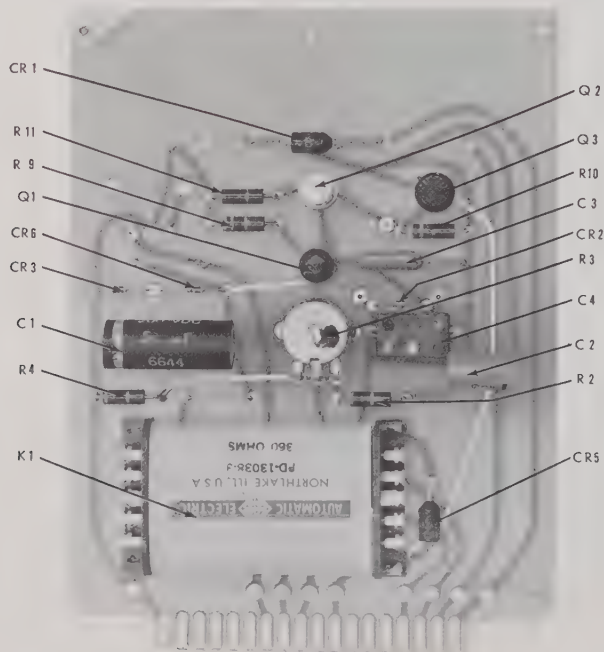


Fig. 6-5 Component Location - E95129

**INSTRUCTION MANUAL
FOR
MODEL TTS 66-1A
DIAL TEST AND HOOKSWITCH
TEST UNITS**



NORTHEAST ELECTRONICS CORPORATION

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SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 DESCRIPTION

1.2 DIAL TEST UNIT. The Dial Test Unit checks the telephone for dial spring ground, speed, % break, and proper quantity of pulses. A binding post is provided on the TTS 66-C Control Unit to attach a clip or probe for the purpose of grounding the telephone under test. The three wires in the line cord are checked for ground, and the DIAL SPRING GROUND lamp will light should ground be present on any of these wires.

1.3 The SPEED of the telephone dial is displayed by three indicator lamps designated HIGH, GOOD and LOW. As the user dials the digit "0", one of the lamps will light, indicating the test results. Screwdriver adjust controls permit adjustment of the high and low limits of the GOOD range.

1.4 The % BREAK of the telephone dial is tested and the results are displayed in the same manner as the speed. HIGH, GOOD and LOW lamps and screwdriver adjust controls to adjust the high and low limits are also provided for the % break test.

1.5 The number of pulses generated by the telephone dial when the digit "0" is dialed are counted to verify that 10 pulses were generated. A counter is stepped by each pulse generated, and if more or less than 10 pulses are counted, the HIGH or LOW lamp will light. If 10 pulses are counted, the DIGIT GOOD lamp will light. It is only necessary to dial one "0" for all of the foregoing three tests.

1.6 The test circuits may be reset during the dial adjustments by depressing the RESET pushbutton, or by depressing the left side of the foot operated switch.

1.7 HOOKSWITCH TEST UNIT. The hook-switch contact closure sequence is tested by

transmitting a 10,000 Hz tone on one side of the input leads of the telephone and monitoring the other side of the input as the hook-switch is moved from ON HOOK to OFF HOOK. The "X" contacts in most telephones must break after the other contacts make. During this interval, the receiver remains momentarily shorted, causing a decrease of impedance across the input to the telephone. The change in level of the tone is detected and converted to a digital input to an electronic storage circuit which determines the correct sequence. If the hookswitch sequence is proper, the HK SW RESULTS DEF lamp is extinguished and the GOOD lamp lights; if not, the DEF lamp remains on.

1.8 The input wires of the telephone are checked for a resistance breakdown to the frame of the telephone by applying 600V dc to the three input leads, and ground to the frame. The DEF lamp will light if there is a breakdown, the GOOD if there is not.

1.9 The HV INTERLOCK pushbutton located on the CONTROL UNIT and the INSULATION BREAKDOWN key must be used for this test, requiring use of both hands. This ensures that the operator's hands are not on the telephone set or input connections when high voltage tests are made.

1.10 SPECIFICATIONS

DIAL SPRING GROUND TEST

a. Check for line ground to frame of telephone.

DIAL SPEED TEST

- a. Lamps indicate HIGH, GOOD or LOW.
- b. Limits adjustable from 8 to 12 pps
- c. Accuracy $\pm 2\%$ of the limit setting.

Section 1
Paragraph 1.10

DIAL % BREAK TEST

- a. Lamps indicate HIGH, GOOD or LOW.
- b. Limits adjustable from 50% to 70% break.
- c. Accuracy $\pm 1\%$ of the limit setting.

NUMBER OF DIGIT DIALED TEST

- a. Lamps indicate HIGH, GOOD or LOW when the digit 0 is dialed.

HOOKSWITCH SPRING SEQUENCE TEST

- a. Lamps indicate GOOD or DEFECTIVE.
- b. Detects that the X contacts remain closed until all the contacts of the main pile-up break.

600V INSULATION BREAKDOWN TEST

- a. Lamps indicate GOOD or DEFECTIVE.
- b. Detects to $50M\Omega$ leakage resistance at $600 \pm 60V$ dc.
- c. High voltage safety interlock.

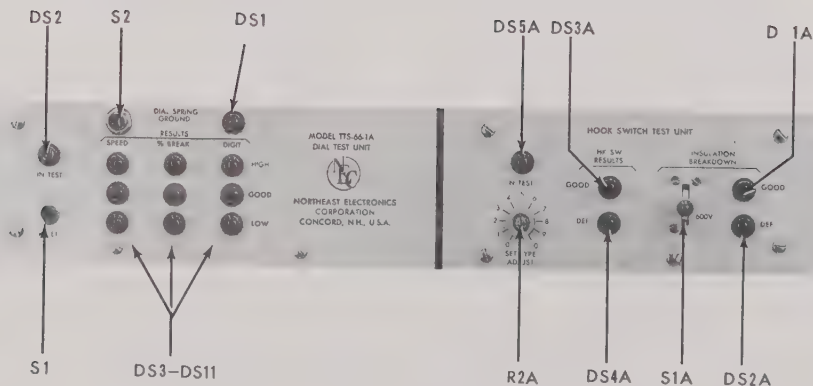


Fig. 2-1 Front Panel Controls

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS. (See figure 2-1).

HOOKSWITCH TEST UNIT

Name of Control	Ref Desig.	Type of Control	Use or Purpose
IN TEST lamp	DS5A	Indicator	Indicates set is prepared for Hookswitch testing.
HK SW RESULTS lamps	DS3A & DS4A	Indicators	Indicate condition of Hook-switch.
INSULATION BREAKDOWN -600V	S1A	Key switch	Used in conjunction with HV INTERLOCK switch to supply 600V dc to L1, L2 and G terminals.
INSULATION BREAKDOWN GOOD-DEF lamps	DS1A & DS2A	Indicators	Indicate condition of insulation under test.
SET TYPE ADJ	R2A	Potentiometer	Used in calibration to accommodate different types of telephones.

DIAL TEST UNIT

Name of Control	Ref Desig.	Type of Control	Use or Purpose
IN TEST lamp	DS2	Indicator	Indicates set is prepared for Dial testing.
DIAL SPRING GROUND pushbutton	S2	Pushbutton switch	Used to test for ground on dial spring.
DIAL SPRING GROUND lamp	DS1	Indicator	Indicates dial spring is grounded.
RESULTS lamps	DS3 to DS11	Indicators	Indicate conditions of dial testing.
RESET pushbutton	S1	Pushbutton switch	Conditions circuit to accept dial pulses.

2.2 OPERATING INSTRUCTIONS.

2.3 PRELIMINARY PROCEDURE. Connect -48V dc and ground to the jack on the rear panel with a cord equipped with a 310 plug on one end with suitable connections on the other. Observe polarity marked on panel. If the test set contains the optional TTS 66 XPS Power Supply, connect the power cord furnished between the connector and a source of 110-120V ac, 60 Hz. On the TTS 66-C control unit, set the POWER switch to ON.

NOTE

The low voltage power supply contained in the TTS 66-C requires a warm-up period of approximately 5 minutes before measurements or calibration procedures can be performed.

2.4 Set the TEST SEQUENCE switch to REMOTE CONTROL.

NOTE

If the foot switch is not used, the TEST SEQUENCE switch will have to be cycled through the different positions as each test is made.

2.5 Connect the telephone set cord to the L1, L2 and G terminals on the TTS 66-C. Connect the FRAME terminal to the finger stop on the dial using the test lead furnished with the unit.

2.6 DIAL TESTING

a. Remove the handset from its cradle

but do not insert it in the acoustic chamber.

b. Depress the right-hand foot switch and note that the DIAL SPRING GROUND lamp does not operate, thus indicating the absence of a ground on the dial spring.

c. Depress the right-hand foot switch. Dial 0 (zero) on the telephone under test; the RESULTS lamps will operate indicating the SPEED, % BRK and DIGIT. This test may be repeated by depressing the left-hand foot switch and dialing 0 (zero).

2.7 HOOKSWITCH TESTS

a. Place the telephone in the on hook position, the HK SW RESULTS DEF lamp should operate.

b. Slowly release the hookswitch on the telephone. If the hookswitch sequence is correct the HK SW RESULTS GOOD lamp should operate.

c. Replace the telephone on hook; the HK SW DEF lamp should operate.

d. Repeat step b and observe the results.

e. Operate the INSULATION BREAKDOWN key to 600V and simultaneously depress the HV INTERLOCK pushbutton on the TTS 66-C front panel. The INSULATION BREAKDOWN GOOD or DEF lamp will operate to indicate satisfactory or defective insulation.

SECTION 3

CIRCUIT DESCRIPTION

3.1 DIAL TEST UNIT. The telephone is connected to the L1 and L2 terminals of the TTS 66-C. The circuit is carried over the TEST SEQUENCE switch contacts or the stepping switch contacts, (depending on the mode of operation), contacts of jack J6 and plug P6 and the normally closed contacts of the DIAL SPRING GND switch, through diode CR4 to the coil of relay K1. Relay K1 remains energized and is interrupted by the dial pulse.

3.2 The L2 terminal is held at ground through a normally closed contact of the DIAL SPRING GND switch. When a digit is dialed, ground pulses are generated and applied to the coils of relays K1 and K2, causing them to pulse. A ground is applied over a normally open contact of K1 and is applied to the coil of the RM stepping relay. Each pulse causes the RM relay to advance one position.

3.3 DIGIT. The RM stepping relay is used to count the dial pulses.

a. A single pulse applies ground for the wiper of the RM relay over its first position contact through diodes CR21 and CR18 to operate the LOW DIGIT lamp.

b. A train of two to nine pulses applies ground for the wiper of the RM relay over contacts two through nine and through CR18 to operate the LOW DIGIT lamp.

c. A train of 10 pulses advances the RM relay to its 10th position extending ground over the normally open contacts through CR16 to operate the GOOD DIGIT lamp. Ground is also applied to the ENABLE relay (K5) through diode CR20 and resistor R15, which extends battery to the SPEED and % BRK RESULTS lamps.

d. A train of greater than 10 pulses advances the RM relay to its 11th position, extending ground through diode CR19 to operate the HIGH DIGIT lamp. Ground is also extended over contacts of the NORM CAL RESET switch (S3) through CR7 to the coil of relay K1. This holds relay K1 energized and the RM is held at the 11th position until unit is reset.

3.4 % BRK. With the RM in its home position, ground is extended to capacitor C3 through CR9, resistor R10 and over normally closed contacts of the TRANSFER relay (K4). This discharges capacitor C3 before a digit is dialed. When a digit is dialed, the RM follows the pulses in the same manner as in the Digit Test. Relay K1 follows the pulse, alternately applying -24V and ground to capacitor C3 through resistors R1 and R2, respectively, over the contacts of K2 and the normally closed contacts of K4. This establishes an average charge on C3 as a function of the make-break ratio of the pulses. After 10 pulses have been received, ground from the RM relay is extended to the coil of relay K4 through the normally open contacts of relay K2, diode CR11 and resistor R11. When relay K4 operates, the charge on capacitor C3 is applied to the Dual Level Detector, Card 1. The limits of the % brk adjustments are determined by resistors R16 through R20.

3.5 SPEED. With the RM relay in its home position, ground is applied to capacitor C4 through CR10, resistor R9 and over normally closed contacts of the TRANSFER relay. This ensures that the capacitor is completely discharged before a digit is dialed. After one pulse, the ground clamp is removed from capacitor C4, allowing it to be charged at a linear rate by the sweep circuit consisting of Q1 and R4. The rate of charge is controlled by resistor R7. After 10 pulses have been received, ground is applied to the

Section 3

Paragraphs 3.6 to 3.12

coil of the TRANSFER relay through the normally open contacts of relay K2, diode CR11 and resistor R11. When this relay operates, the charge of capacitor C4 is applied to the Dual Level Detector, Card 2. The limits of the speed adjustments are determined by resistors R21 through R25.

3.6 RESET. Resetting is accomplished when either the RESET switch (S1) on the front panel or the left foot switch is depressed, extending ground through R13 to the coil of the RESET relay K3. The timing circuit consisting of R13 and C1 holds K3 energized long enough to allow complete reset. The RM relay is normally energized when ground is extended through the normally open contact of K1. Operation of relay K3 removes this ground and extends ground to the RM relay through its interrupter contact and diode CR21, CR13, CR14 or CR15, advancing the RM relay one position every interruption.

3.7 RESET CAL NORM. This switch is provided for the calibration of the speed and % brk circuits. With the switch in the CAL position, after 10 pulses have been received ground is extended to the coil of relay K1 over the normally open contacts of relay K2, through S3 and diode CR7. Relays K1 and K2 are prevented from accepting any more than 10 pulses and the RM relay remains at the 10th position. The RESET position connects the anode of the diode CR7 to the home position of the RM relay. The RM is allowed to advance to its home position and ground is extended through CR7 to the coil of relay K1 and the RM relay is held at the home position.

3.8 HOOKSWITCH TEST UNIT. The telephone is connected to the L1-L2 terminals, or the standard telephone jack. The hookswitch test unit is energized either by setting the TEST SEQUENCE (in the TTS 66-C control unit) switch S4 to HOOKSWITCH or remotely advancing the RM relay to position 3.

3.9 A 10 kHz continuous tone superimposed on a dc level is generated at pin T of the Hookswitch Sequence Detector, Card 3. The combined signal is carried over contacts of the INSULATION BREAKDOWN key where it is applied to L1 of the telephone. As the

hookswitch is released, the signal is passed through the telephone network and appears at L2, where it is carried back to pin C of Card 3 over contacts of switch S1A.

3.10 The operation of most common hookswitches require that the set of contacts normally shunting the receiver element does not break until all other contacts have made, when operated from on hook to off hook. This action tends to modulate the impressed signal in the following manner:

a. In the on hook condition, no signal is allowed to pass to L2. At a certain point during its release the hookswitch contacts will connect L2 and L1 to the network, providing a path for the signal.

b. At the completion of the release, the contacts shunting the receiver break, and effectively increase the ac impedance in the path.

c. The resulting composite signal is processed through Card 3 which recognizes the corresponding decrease in tone level and converts this to digital information to display by the RESULTS lamps.

3.11 The SET TYPE ADJ control (R2A) adjusts the sensitivity of the input circuitry to accommodate for different telephone responses to the impressed signal.

3.12 INSULATION BREAKDOWN TEST. This test is part of the hookswitch test unit, and checks for over-voltage breakdown between L1, L2, G to the frame of the telephone. Simultaneous operation of the HV INTERLOCK switch (S3 in the control unit) and the INSULATION BREAKDOWN key (S1A) extends battery to energize the HV supply (Card 2 in the control unit). Battery is also applied to the timing network, R27-C5, which causes a delay in the operation of the INT relay K6. Operating S1A also removes L1, L2 and G from Card 3 and transfers them to the output of the high voltage supply. After sufficient time delay required for stabilization of the high voltage level, the INT relay transfers

ground from the frame input to enable the display circuitry on the HV Breakdown Detector (Card 3 in the control unit).

3.13 DC leakage current flowing into the FRAME terminal is applied to the input of

the HV Breakdown Detector through the variable current divider R2-R3 in the control unit. The detector senses whether the breakdown current exceeds the preset limit determined by R2 and displays the results by operating lamp DS1A or DS2A.

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 CALIBRATION. The following calibration procedures should be carried out periodically to ensure that the operating parameters of the set remain within their specified limits.

4.2 TEST EQUIPMENT REQUIRED

1. Low frequency oscillator - Hewlett Packard 200CD or equivalent
2. Polar relay with a coil resistance of 1000 Ω or higher.
3. Pulse Signaling Test Set - NEC TTS 26B or equivalent
4. Volt ohmmeter.

4.3 PRELIMINARY PROCEDURE. To operate the test set on office battery, plug a 310-type plug into the jack on the rear panel, observing polarity marked on panel. If the test set contains the optional TTS 66XPS Power Supply, connect the power cord fur-

nished with the set between the connector and a source of 110-120V ac, 60 Hz. On the TTS 66-C control unit, set the POWER switch to ON.

NOTE

The low voltage power supply contained in the TTS 66-C requires a warm-up period of approximately 5 minutes before measurements or calibration procedures can be performed.

4.4 Connect the foot switch to the rear of the test set.

4.5 DIAL TEST UNIT CALIBRATION.

4.6 DIAL SPEED TEST CALIBRATION. Open top cover to allow access to the internal controls. Perform the checks and adjustments in the following sequence:

CONTROL	ACTION	RESULTS
1. TEST SEQUENCE Control	Set to DIAL.	IN TEST lamp should operate on Dial Test Unit.
2. R22 SPEED HI	Set fully CW.	
3. R23 SPEED LO	Set fully CCW.	
4. (See Fig. 4-1 for test set-up).	Turn oscillator on and adjust its frequency for the desired high speed limit.	
5. RESET-CAL-NORM	Set to RESET for approximately 5 seconds then release	Observe that RESULTS-SPEED-GOOD lamp operates after set receives 10 pulses.
6. R22 SPEED HI	Adjust R22 while repeating step 5 until correct result is obtained.	RESULTS-SPEED lamps should change from GOOD to HIGH.

CONTROL	ACTION	RESULT
7.	Adjust oscillator for desired low speed limit.	
8. R23 SPEED LO	Adjust R23 while repeating steps 5 and 6 until correct result is obtained.	RESULTS SPEED lamp should change from GOOD to LOW.
9. RESET CAL NORM	Return switch to NORM position.	

4.7 The set is now calibrated for checking dial speed with the required upper and lower speed limits.

4.8 DIAL % BREAK TEST CALIBRATION. Open top cover to allow access to the internal controls.

4.9 Set the front panel controls on the TTS 26B as indicated below.

4.10 Connect the output of the TTS 26B (SEND jacks 1 or 2) to the L1 or L2 terminals on the TTS 66-C front panel.

4.11 Calibrate the TTS 26B to send the required upper limit of % break at 10 pulses per second. The maximum GOOD range on the Dial Test Unit is from 50 to 70% break. Perform the checks and adjustments in the following sequence:

TTS 26B Front Panel Settings

CONTROL	SETTING
FUNCTION	SEND AND REC
PULSES PER SEC	10
SEND	SND-LOOP
SEND TURNBUTTON	RT ON 1 & 2

CONTROL	ACTION	RESULT
1. TEST SEQUENCE Control	Set to DIAL	IN TEST lamps on Dial Test Unit should operate.
2. R17, % BRK HI	Set fully CW.	
3. R18, % BRK LO	Set fully CCW.	
4. RESET CAL NORM	Set to RESET for approximately 5 seconds then release.	Observe that % BRK GOOD lamp operates after set receives 10 pulses.
5. R17, % BRK HI	Adjust R17 while repeating step 4 until correct result is obtained.	RESULTS-% BRK lamp should change from GOOD to HIGH.
6.	Recalibrate TTS 26B to send the required lower limit of %	

ADDENDUM TO SECTION 4

ALTERNATE METHOD OF CALIBRATION

4.1 CALIBRATION. The following calibration procedures should be carried out periodically to ensure that the operating parameters of the set remain within their specified limits.

4.2 TEST EQUIPMENT REQUIRED

1. TTS 46XB-1 Dial Pulse Generator
2. TTS 46A Dial Pulse Test Set

4.3 PRELIMINARY PROCEDURE. To operate the test set on office battery, plug a 310-type plug into the jack on the rear panel, observing polarity marked on panel. If the test set contains the optional TTS 66XPS Power Supply, connect the power cord furnished with the set between the connector and a source of 110-120V ac, 60 Hz. On the TTS 66-C control unit, set the POWER switch to ON.

4.4 Connect the footswitch to the rear of the test set.

4.5 DIAL TEST UNIT CALIBRATION.

4.6 DIAL SPEED TEST CALIBRATION. Open cover to allow access to the internal controls. Perform the checks and adjustments in the following sequence:

NOTE

The low voltage power supply contained in the TTS 66-C requires a warm-up period of approximately 5 minutes before measurements or calibration procedures can be performed.

CONTROL	ACTION	RESULTS
1. TEST SEQUENCE Control	Set to DIAL.	IN TEST lamp should operate on Dial Test Unit.
2. R22 SPEED HI	Set fully CW.	
3. R23 SPEED LO	Set fully CCW.	
4. Refer to TTS 46XB-1 Operating Instructions for test set-up procedure.	Turn on TTS 46XB-1 and adjust for desired high speed limit.	
5. RESET-CAL-NORM	Set to RESET for approximately 5 seconds then release.	Observe that RESULTS-SPEED-GOOD lamp operates after set receives 10 pulses.
6. R22 SPEED HI	Adjust R22 while repeating step 5 until correct result is obtained.	RESULTS-SPEED lamps should change from GOOD to HIGH.

CONTROL	ACTION	RESULT
7.	Adjust TTS 46XB-1 for desired low speed limit.	
8. R23 SPEED LO	Adjust R23 while repeating steps 5 and 6 until correct result is obtained.	RESULTS SPEED lamp should change from GOOD to LOW.
9. RESET CAL NORM	Return switch to NORM position.	

4.7 The set is now calibrated for checking dial speed with the required upper and lower speed limits.

4.8 DIAL % BREAK TEST CALIBRATION. Open top cover to allow access to the internal controls.

4.9 Prepare the TTS 46XB-1 for operation as described in its operating instructions.

4.10 Connect the output of the TTS 46XB-1 to the L1 or L2 terminals on the TTS 66-C front panel.

4.11 Calibrate the TTS 46XB-1 to send the required upper limit of % break at 10 pulses per second. The maximum GOOD range on the Dial Test Unit is from 50 to 70% break. Perform the checks and adjustments in the following sequence:

CONTROL	ACTION	RESULT
1. TEST SEQUENCE Control	Set to DIAL	IN TEST lamps on Dial Test Unit should operate.
2. R17, % BRK HI	Set fully CW.	
3. R18, % BRK LO	Set fully CCW.	
4. RESET CAL NORM	Set to RESET for approximately 5 seconds then release.	Observe that % BRK GOOD lamp operates after set receives 10 pulses.
5. R17, % BRK HI	Adjust R17 while repeating step 4 until correct result is obtained.	RESULTS-% BRK lamp should change from GOOD to HIGH.
6.	Recalibrate TTS 46XB-1 to send the required lower limit of % break at 10 pulses per second.	

CONTROL	ACTION	RESULT
6.	break at 10 pulses per second.	
7. R18, % BRK LO	Adjust R18 while repeating step 4 until correct result is obtained.	RESULTS % BRK lamp should change from GOOD to LOW.
8. RESET CAL NORM	Return switch to NORM position.	

4.12 The set is now calibrated for checking % break with the required upper and lower limits.

TION. Perform the checks and adjustments in the following sequence for each type of telephone to be tested:

4.13 HOOKSWITCH TEST UNIT CALIBRA-

CONTROL	ACTION	RESULT
1. TEST SEQUENCE	Set to HOOKSWITCH	
2.	Connect a known good telephone set to the L1 and L2 terminals.	HK SW RESULTS DEF lamp should operate with telephone on hook.
3. SET TYPE ADJ	Loosen locking nut and rotate fully CW.	
4.	Condition telephone transmitter by rotating the handset in an arc of 180° both CW and CCW.	
5.	Alternately release the telephone hookswitch and rotate SET TYPE ADJUST control CCW until results GOOD are observed.	HK SW RESULTS GOOD lamp will come on at high limit. Note this point.
6.	Repeat the action of step 5 until the low limit is determined.	HK SW RESULTS GOOD lamp will go out at low limit. Note this point.
7. SET TYPE ADJ	Set control at midpoint of the high and low limits determined in steps 5 and 6. Tighten locking nuts.	

4.14 INSULATION BREAKDOWN. The INSULATION BREAKDOWN control (R2) is located within the TTS 66-C control unit. This control is factory set for a low limit of 48MΩ. Rotating the control clockwise will raise this low limit.

performed before attempting more detailed troubleshooting.

a. Check to see that the power connection on the rear panel is correctly connected to the proper external power source:

4.15 MAINTENANCE INSTRUCTIONS. In the event of a malfunction in the operation of the set, the following simple checks should be

1. DC (office battery): 44-52V

Section 4

Paragraphs 4.16 and 4.19

dc, tip negative, ring or sleeve positive:

or

2. AC (for use only when equipped with TTS 66XPS or PS101R regulated 48V dc power supply): 115V ac 60 Hz.

b. Check that all fuses are installed and are of the specified type and rating.

c. Check that all interconnecting plugs are fully mated with the correct receptacles on the rear of the TTS 66-C control unit and rear panel.

4.16 If the malfunction is not cleared during the previous steps, proceed as follows with POWER switch in the OFF position.

a. Completely remove the affected unit from the console by removing the 4 front panel screws and carefully sliding the unit forward and out. The interconnecting cable will be long enough to allow the unit to be placed on the bench adjacent to the console without disengaging.

b. To gain access to the plug-in component boards, remove the two screws in the upper corners of the hinged rear chassis plate and allow it to swing down (TTS 66-C unit only). The cards should be removed with the

extractor key, pulling straight back until the guides are cleared.

c. Perform a visual inspection of the unit looking for broken or shorted wires, damaged components and other obvious faults.

d. Check that all plug-in cards are in their correct locations and are fully engaged.

e. Check that all plug-in components (including lamps) are fully engaged in their respective sockets.

f. Check operation of panel switches noting that they operate freely. Visually inspect contacts to ensure positive electrical connections. If required, clean contacts with a good contact cleaner.

4.17 DC POWER DISTRIBUTION

a. Unless otherwise indicated, all voltages are referred to "ground". Connections to ground can always be made to either pin #1 on all interconnecting plugs and sockets or pin A of plug-in component cards.

b. With POWER switch set to ON, select the desired test and measure the appropriate dc voltages in accordance with table below.

TEST SELECTED	CONTROL OPERATED	-44 to -52V dc		-21 to -24V dc	
		Card or Plug	Pin #	Card or Plug	Pin #
DIAL	NONE	P-6	4	P-6	3
HOOKSWITCH	NONE	P-6	12	P-6	11
HOOKSWITCH	HV INTERLOCK	P-6	17	-	-

4.18 OPERATIONAL CHECKS AND ADJUSTMENTS

4.19 DIAL TEST UNIT

a. Set the TEST SEQUENCE switch to DIAL and depress the RESET button to ensure that DIAL SPRING GROUND lamp is operational.

b. DIAL SPRING GROUND pushbutton. Observe that the associated lamp operates when each of L1, L2 or G terminals is shorted to the FRAME terminal.

c. To check the SPEED sweep circuit, proceed as follows:

d. Connect a telephone set to the L1 and

L2 terminals and place the handset off hook.

e. Using an oscilloscope, monitor the voltage appearing at point "A" on CB2. (See fig. 6-2, page 6-3).

f. Depress RESET, dial the digit "1" and observe the following linear sweep waveform illustrated in fig. 4-2.

g. Alternately adjust R7 on CB2 and repeat step f if required to correct ramp slope.

4.20 HOOKSWITCH TEST UNIT

a. To check the INSULATION BREAKDOWN test voltage connect a VOM to L1 terminal, referenced to the FRAME terminal. Set the TEST SEQUENCE switch to HOOKSWITCH.

b. Simultaneously depress the HV INTERLOCK and operate the INSULATION BREAKDOWN switch. Measure a voltage of -600 ± 60 V dc.

c. Repeat steps 1 and 2 for L2 and G terminals.

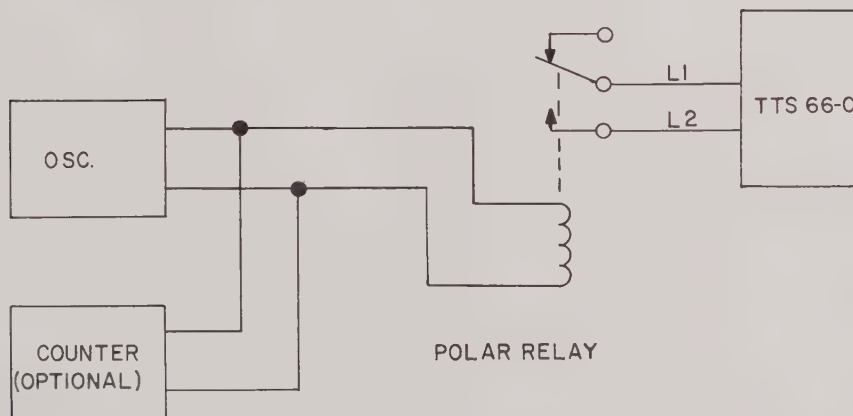


Figure 4-1 Dial Speed Test Setup.

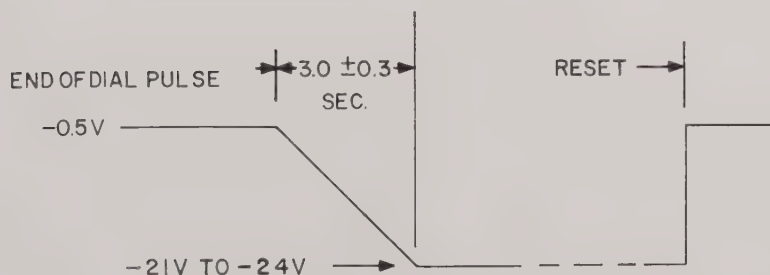


Figure 4-2 Dial Test Unit Typical Waveform

SECTION 5

SCHEMATIC DIAGRAMS

5.1 INTRODUCTION. The following pages contain the schematic diagrams for the TTS 66-1A Dial Test Unit and Hook Switch Test Unit. Wherever possible, all the information is contained on one diagram, however, because of limitation in printing some of the individual printed circuit boards are illustrated on separate sheets.

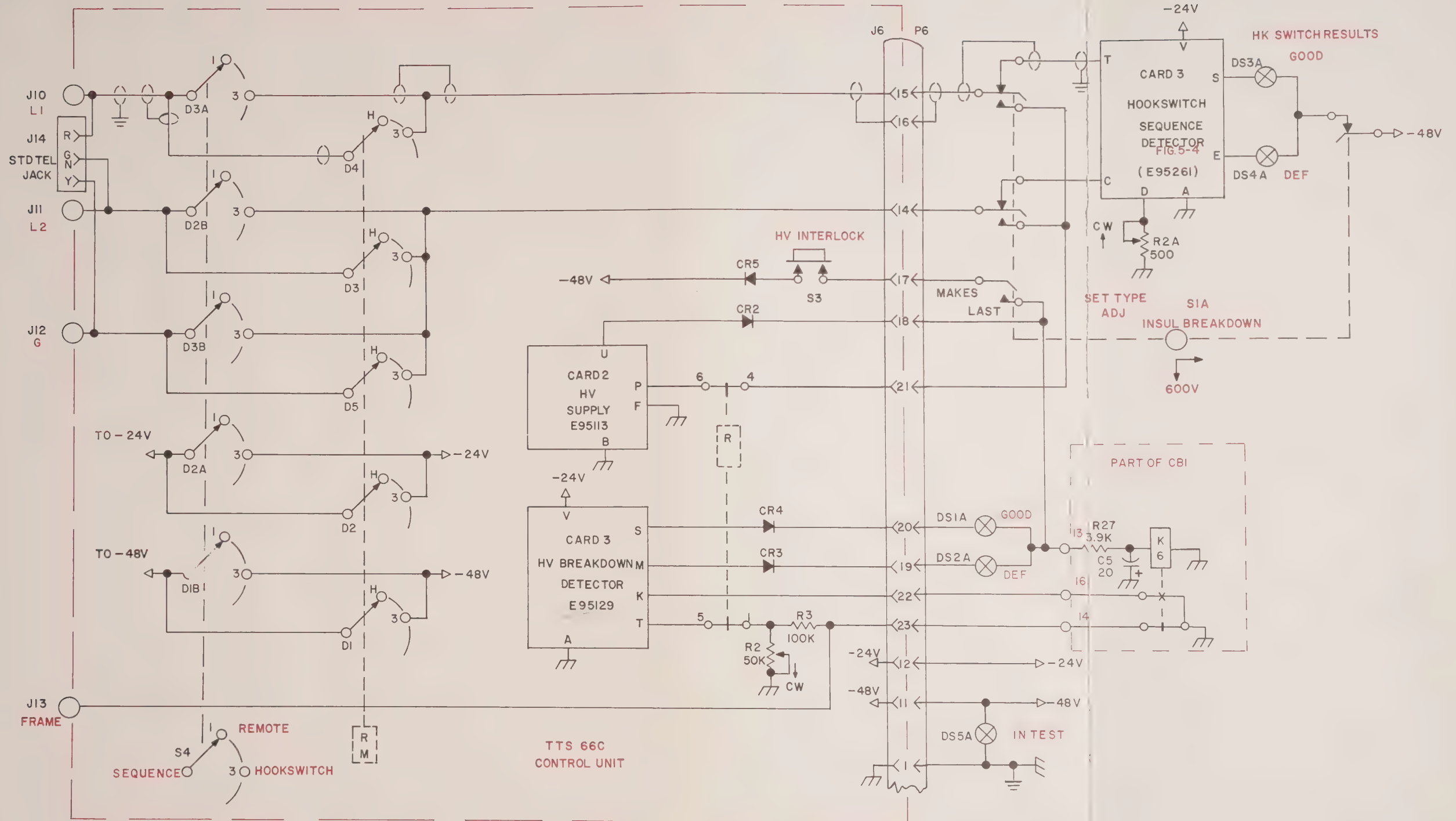


Fig. 5-2 Hookswitch Test Unit

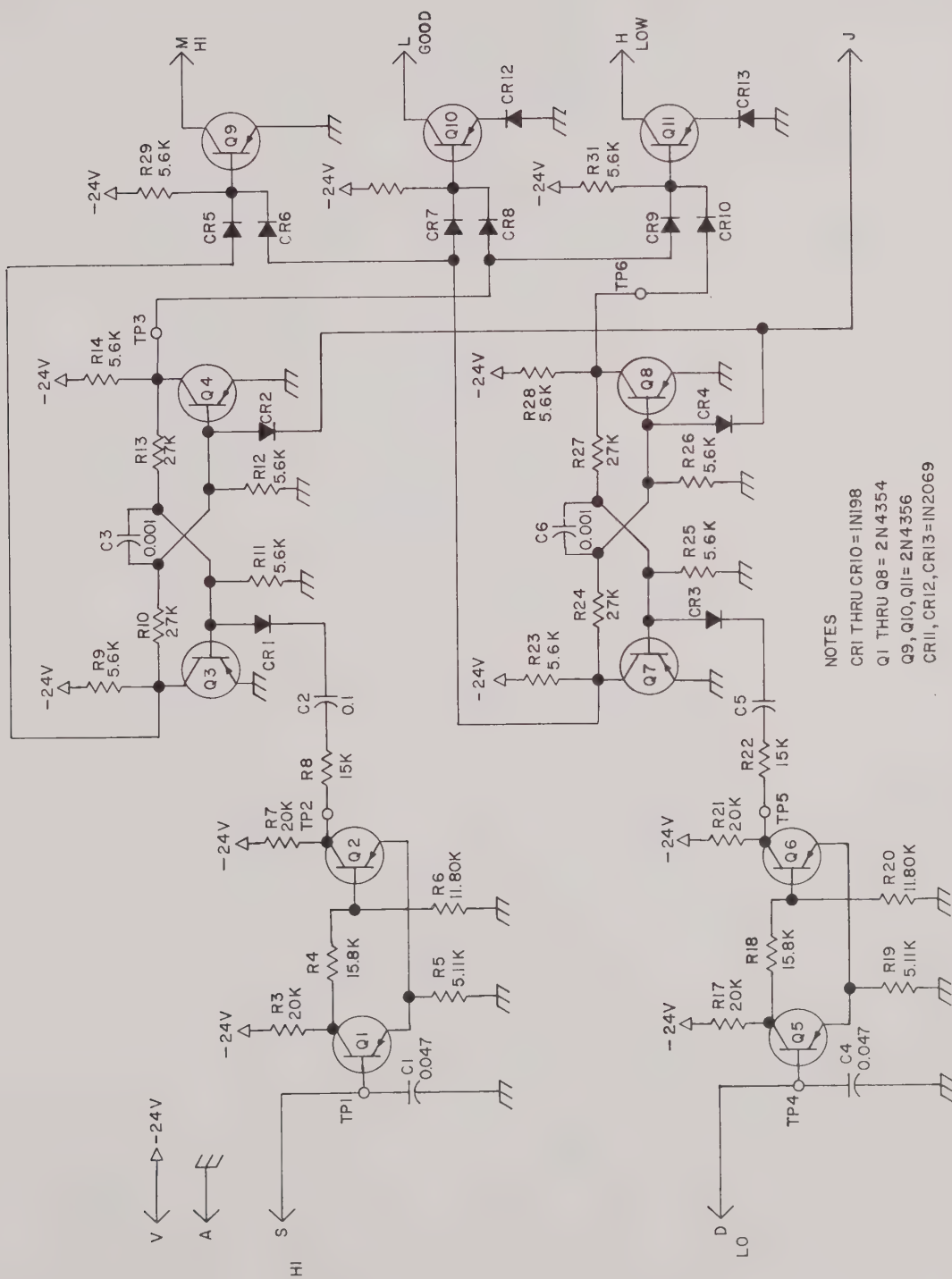


Fig. 5-3 Dual Level Detector - E95168

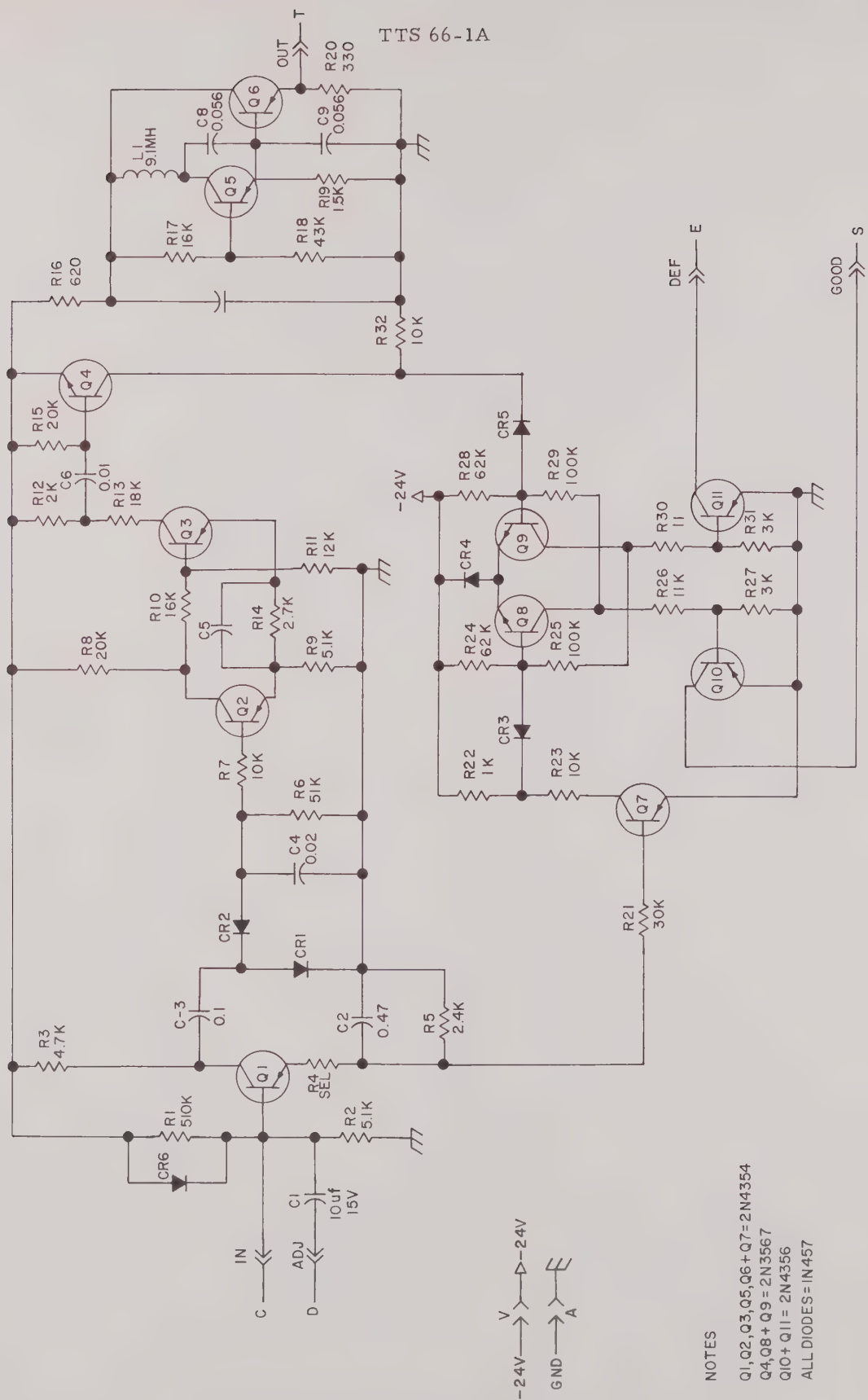


Fig. 5-4 Hookswitch Sequence Detector - E95261

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the TTS 66-1.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of these codes and their respective manufacturers is given below.

Code No.	Manufacturers
01121	Allen Bradley
04773	Automatic Electric
06819	NEC
07716	IRC
13606	Sprague
17803	Fairchild
24446	General Electric
31356	J-B-T Instruments
72663	General Controls
77342	Potter & Brumfield
78277	Sigma
80368	Sylvania
82389	Switchcraft
82872	Roanwell
90201	Mallory

6.3 Abbreviations used in the parts list.

C - capacitor	R - resistor
S - switch	Pot - potentiometer
fxd - fixed	ww - wirewound
mtl flm - metal film	sel val - selected value
elect - electrolytic	comp - composition

CB1

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd elect 50 μ F 50V	13606	TVA-1308
C2	C: fxd flm 0.47 μ F 75V	13606	225P
R13	R: fxd comp 3.9K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R14	R: fxd comp 220 Ω $\pm 10\%$ $\frac{1}{2}$ W	01121	
R15	R: fxd comp 3.9K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R26	R: fxd comp 10K $\pm 10\%$ $\frac{1}{2}$ W	01121	
CR1	Diode: silicon	80368	1N2069
CR13 thru CR15	Diodes: silicon	80368	1N2069
CR16 thru CR21	Diodes: silicon	80368	1N2069
CR22	Diode: silicon	80368	1N457
K3 and K5	Relays: 24V coil	78277	65FP1A
RM	Relay: stepping switch 600 Ω coil	77342	CM-1124

CB2

C3 and C4	C: fxd ppr 4 μ F 150V	13606	121P4
C5	C: fxd elect 20 μ F 50V	13606	TE 1305
R1 and R2	R: mtl flm fxd 100K $\pm 1\%$ $\frac{1}{2}$ W	07716	CECTO
R3	R: fxd comp 30K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R4	R: fxd mtl flm 33.333K $\pm 1\%$ $\frac{1}{2}$ W	07716	CECTO
R5	R: fxd mtl flm 4439.5 Ω $\pm 1\%$ $\frac{1}{2}$ W	07716	CECTO
R6	R: fxd comp 20K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R7	R: var comp 20K pot	90201	MTC-4
R8	R: fxd mtl flm 47.5K $\pm 1\%$ $\frac{1}{2}$ W	07716	CECTO
R9	R: fxd comp 100 Ω $\pm 10\%$ $\frac{1}{2}$ W	01121	
R10	R: fxd comp 82K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R11	R: fxd ww 300 Ω $\pm 5\%$ 3W	13606	242E3015
R12	R: fxd comp 10K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R27	R: fxd comp 3.9K $\pm 10\%$ $\frac{1}{2}$ W	01121	
TH1	Thermistor: 30K	82872	43R1
Q1	Transistor: NPN	24446	2N3568
CR4	Diode: silicon	80368	1N2069
CR6	Diode: silicon	80368	1N457
CR7	Diode: silicon	80368	1N2069
CR8 thru CR10	Diodes: silicon	80368	1N457
CR11	Diode: silicon	80368	1N2069
CR12 & CR23	Diodes: silicon	80368	1N457
K1, K2 & K4	Relays: 360 Ω coil	04773	PD13038-3
K6	Relay: 24V dc	78277	65FP1A

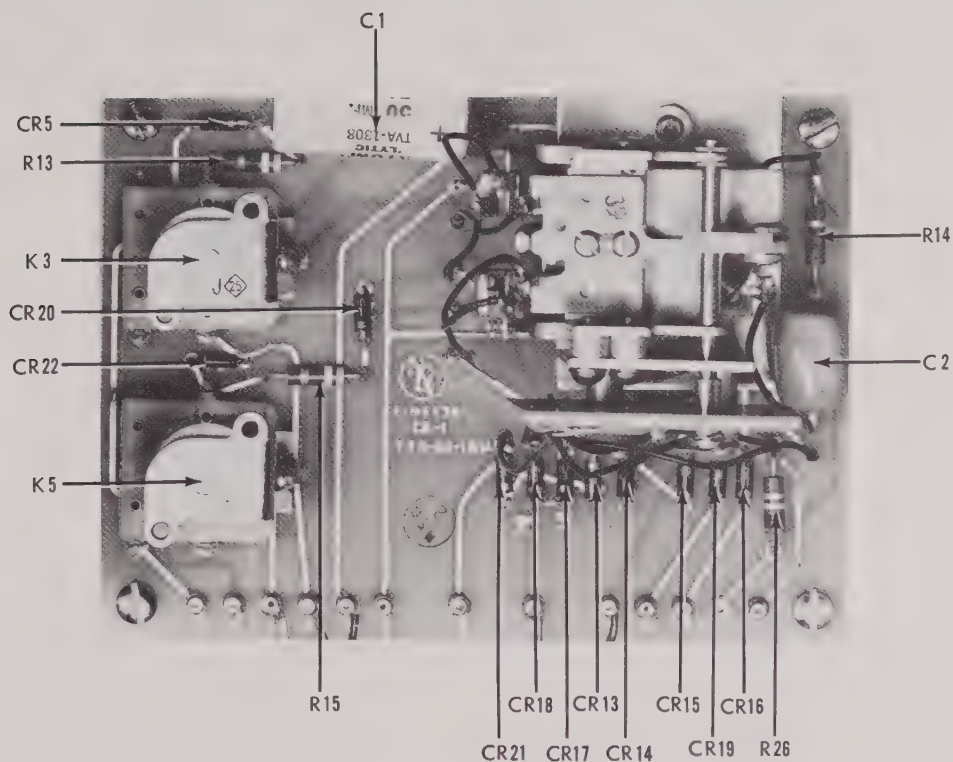


Fig. 6-1 CB1 Component Location

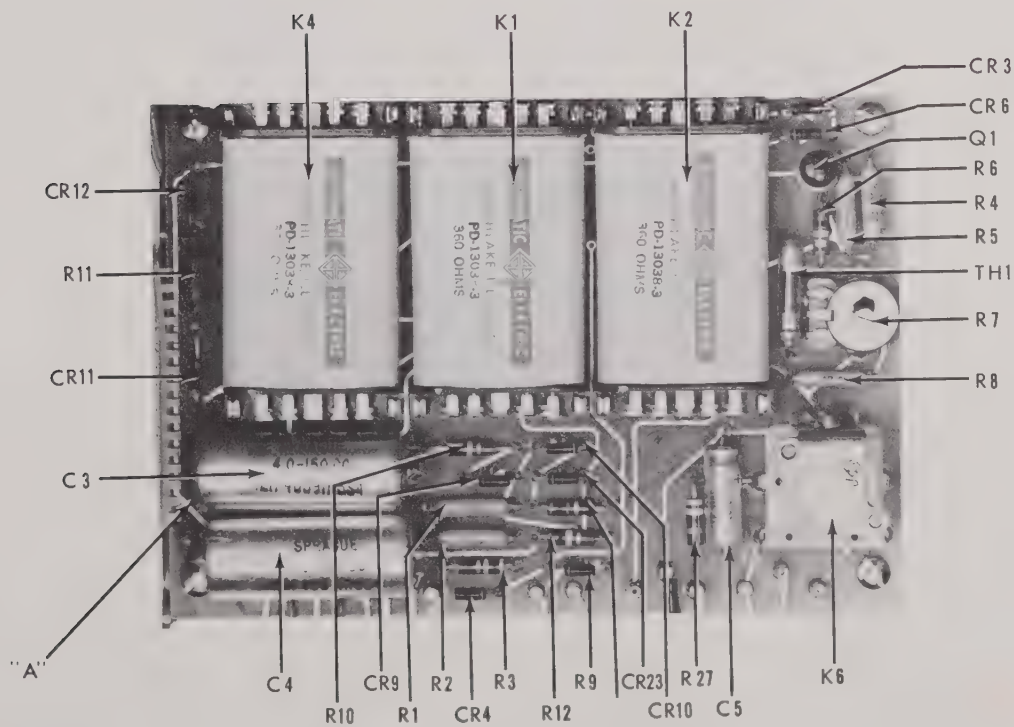


Fig. 6-2 CB2 Component Location

Section 6

CB3

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R16	R: fxd mtl flm $2670\Omega \pm 1\% \frac{1}{2}W$	07716	CECTO
R17 and R18	Pots: var comp 5K	90201	MTC-4
R19	R: fxd mtl flm $7360\Omega \pm 1\% \frac{1}{2}W$	07716	CECTO
R20	R: fxd mtl flm $5900\Omega \pm 1\% \frac{1}{2}W$	07716	CECTO
R21	R: fxd mtl flm $3240\Omega \pm 1\% \frac{1}{2}W$	07716	CECTO
R22, R23	R: Pots: var comp 5K	90201	MTC-4
R24	R: fxd mtl flm $22.1K \pm 1\% \frac{1}{2}W$	07716	CECTO
R25	R: fxd mtl flm $18.7K \pm 1\% \frac{1}{2}W$	07716	CECTO

Main Assembly

S1	S: pushbutton 1C	82389	913
S2	S: pushbutton 2C	82389	4006
S3	S: toggle 2C locking/nonlocking	31356	JMT-223
DS1 thru DS11	Lamps: 60V	80368	60A
Cards #1 & 2	PC Boards	06819	E95168
Cards #3	PC Board	06819	E95261
R2	R: var 500Ω ww		
DS1A thru 5A	Lamps: 60V	80368	60A
S1A	S: telephone key, nonlocking	72663	MCT4-T5-2C-00

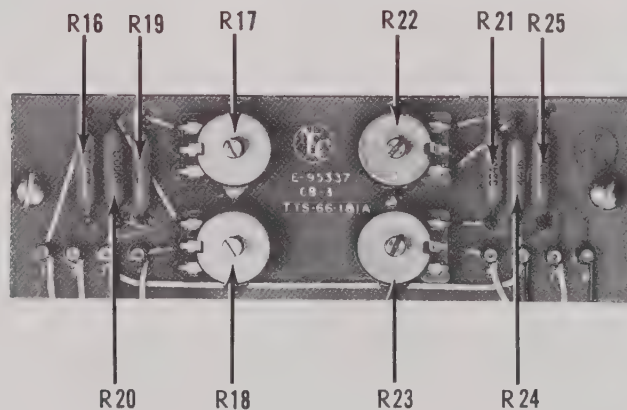


Fig. 6-3 CB3 Component Location

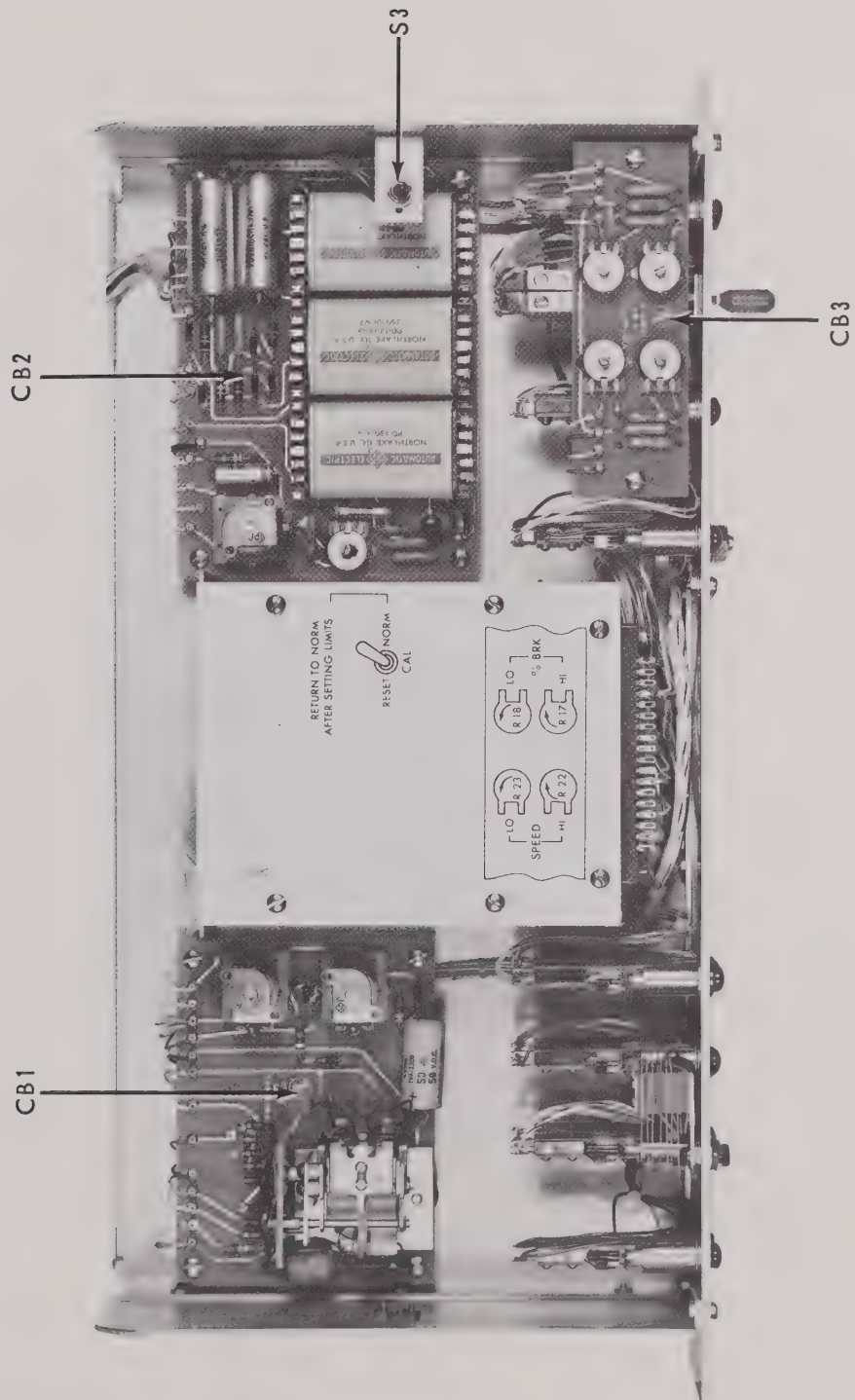


Fig. 6-4 TTS 66-1A Top View

DUAL LEVEL DETECTOR (Cards 1 & 2)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
CR1 thru CR10	Diodes: germanium	80368	1N198
CR11 thru CR13	Diodes: silicon	80368	1N2069
Q1 thru Q8	Transistors: PNP	17803	2N4354
Q9 thru Q11	Transistors: PNP	17803	2N4356

(continued on page 6-8)

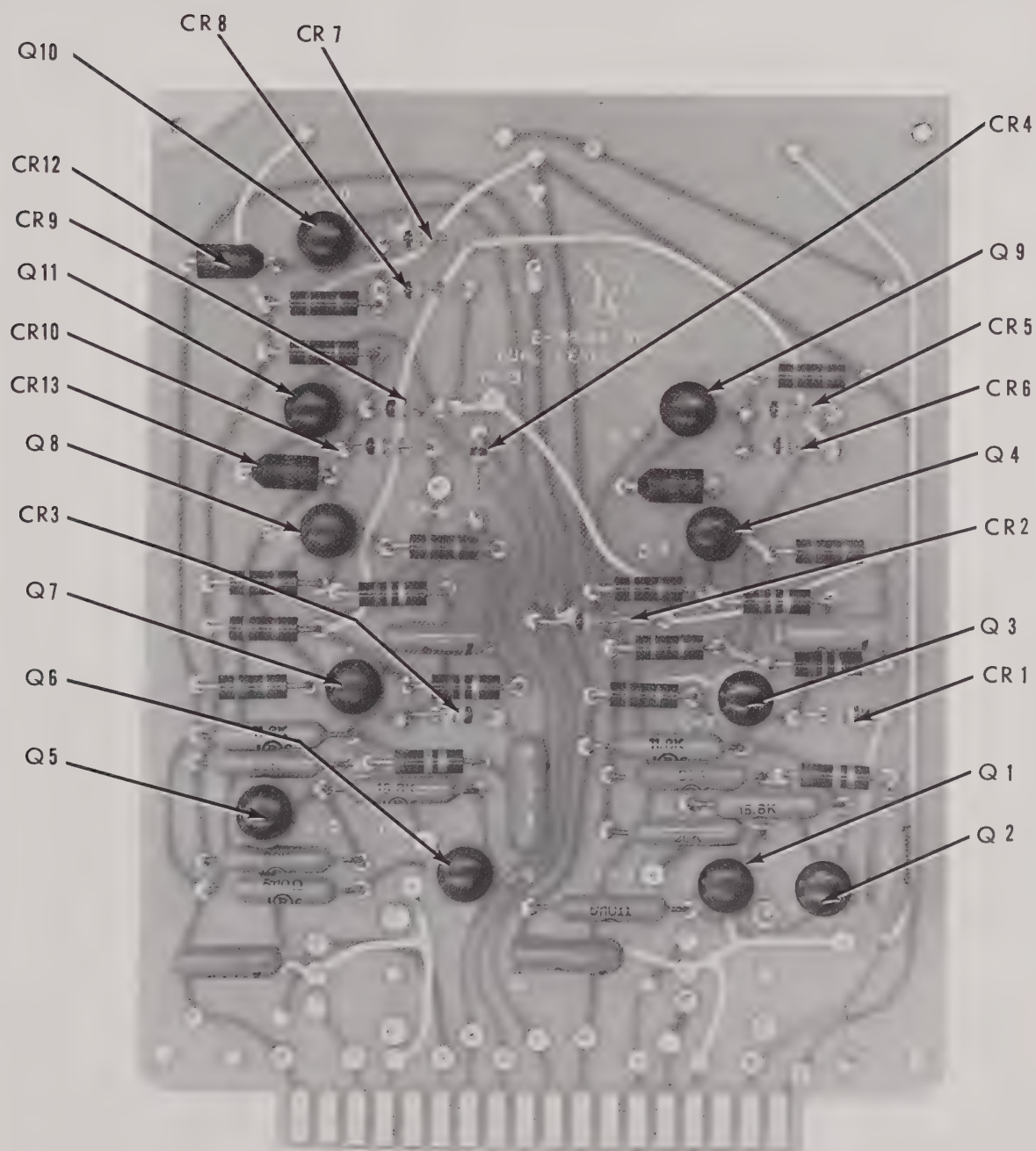


Fig. 6-5 E95168 - Rev. 2 Dual Level Detector

DUAL LEVEL DETECTOR (Cards 1 & 2) (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd flm 0.047 μ F	13606	225P
C2	C: fxd flm 0.1 μ F	13606	225P
C3	C: fxd flm 0.001 μ F	13606	225P
C4	C: fxd flm 0.047 μ F	13606	225P
C5	C: fxd flm 0.1 μ F	13606	225P
C6	C: fxd flm 0.001 μ F	13606	225P
R1 and R2	not used		
R3	R: fxd mtl flm 20K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R4	R: fxd mtl flm 15.8K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R5	R: fxd mtl flm 5.11K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R6	R: fxd mtl flm 11.8K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R7	R: fxd mtl flm 20K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R8	R: fxd comp 15K $\pm 10\% \frac{1}{2}W$	01121	
R9	R: fxd comp 5.6K $\pm 10\% \frac{1}{2}W$	01121	
R10	R: fxd comp 27K $\pm 10\% \frac{1}{2}W$	01121	
R11 and R12	R: fxd comp 5.6K $\pm 10\% \frac{1}{2}W$	01121	
R13	R: fxd comp 27K $\pm 10\% \frac{1}{2}W$	01121	
R14	R: fxd comp 5.6K $\pm 10\% \frac{1}{2}W$	01121	
R15 and R16	R: not used		
R17	R: fxd mtl flm 20K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R18	R: fxd mtl flm 15.8K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R19	R: fxd mtl flm 5.11K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R20	R: fxd mtl flm 11.8K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R21	R: fxd mtl flm 20K $\pm 1\% \frac{1}{2}W$	07716	CECTO
R22	R: fxd comp 15K $\pm 10\% \frac{1}{2}W$	01121	
R23	R: fxd comp 5.6K $\pm 10\% \frac{1}{2}W$	01121	
R24	R: fxd comp 27K $\pm 10\% \frac{1}{2}W$	01121	
R25 and R26	R: fxd comp 5.6K $\pm 10\% \frac{1}{2}W$	01121	
R27	R: fxd comp 27K $\pm 10\% \frac{1}{2}W$	01121	
R28 thru R31	R: fxd comp 5.6K $\pm 10\% \frac{1}{2}W$	01121	

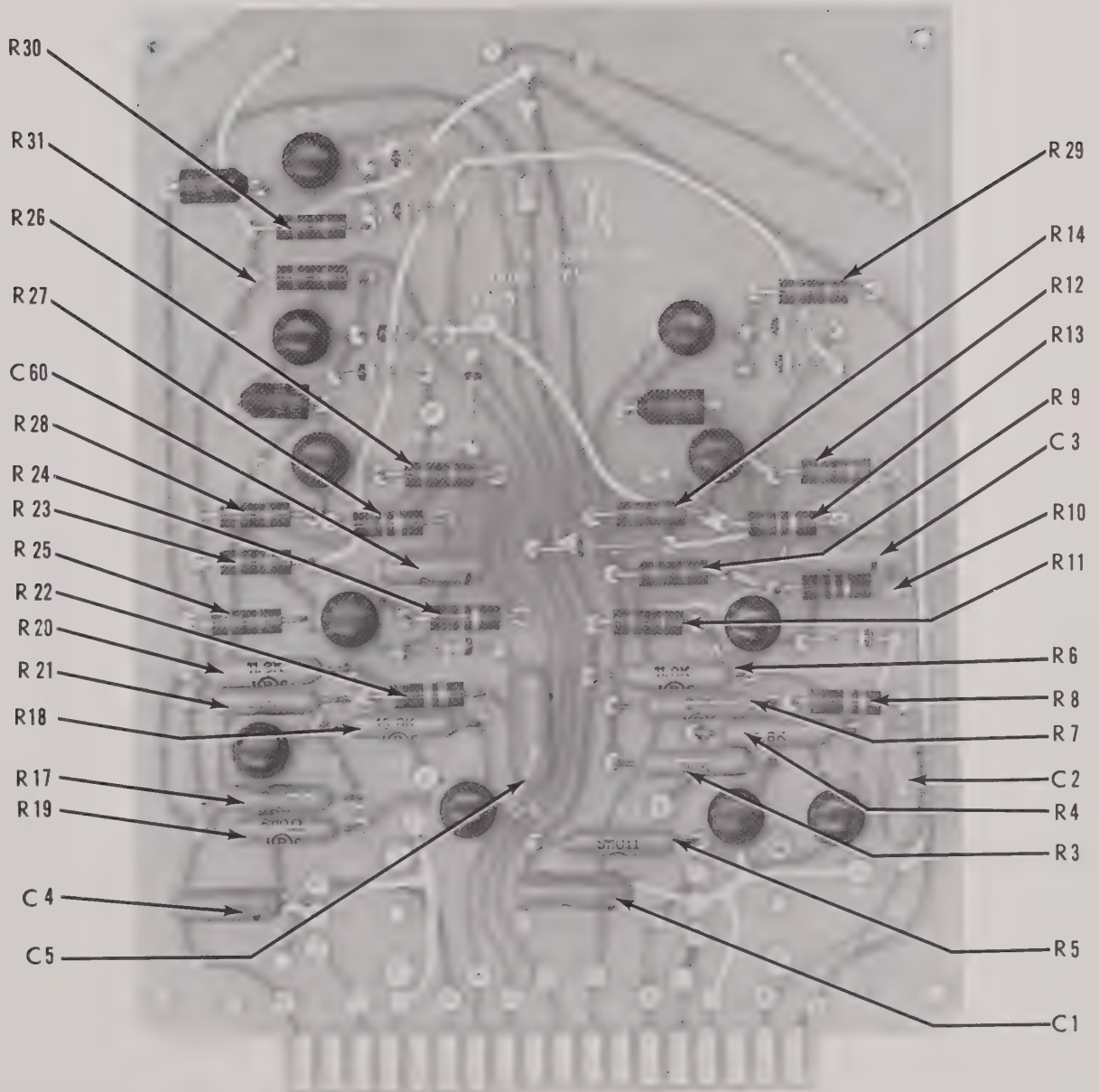


Fig. 6-6 E95168 - Rev. 2 Dual Level Detector

Section 6

HOOKSWITCH SEQUENCE DETECTOR (Card #3)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd elect 10 μ F 15V	13606	TE 1155
C2	C: fxd flm 0.47 μ F 75V	13606	225P
C3	C: fxd flm 0.1 μ F 100V	13606	225P
C4	C: fxd flm 0.022 μ F 75V	13606	225P
C5	C: fxd flm 0.001 μ F 100V	13606	225P
C6	C: fxd flm 0.1 μ F 100V	13606	225P
C7	C: fxd elect 20 μ F 25V	09653	APD-046
C8 and C9	C: fxd flm 0.056 μ F 100V	13606	225P
R1	R: fxd comp 510 Ω $\pm 5\%$ $\frac{1}{2}$ W	01121	
R2	R: fxd comp 5.1K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R3	R: fxd comp 4.7K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R4	R: fxd comp sel val $\pm 10\%$ $\frac{1}{2}$ W	01121	
R5	R: fxd comp 2.4K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R6	R: fxd comp 51K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R7	R: fxd comp 10K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R8	R: fxd comp 20K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R9	R: fxd comp 5.1K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R10	R: fxd comp 16K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R11	R: fxd comp 12K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R12	R: fxd comp 2K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R13	R: fxd comp 18K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R14	R: fxd comp 2.7K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R15	R: fxd comp 20K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R16	R: fxd comp 620 Ω $\pm 5\%$ $\frac{1}{2}$ W	01121	
R17	R: fxd comp 16K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R18	R: fxd comp 43K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R19	R: fxd comp 1.5K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R20	R: fxd comp 330 Ω $\pm 10\%$ $\frac{1}{2}$ W	01121	
R21	R: fxd comp 30K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R22	R: fxd comp 1K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R23	R: fxd comp 10K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R24	R: fxd comp 62K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R25	R: fxd comp 100K $\pm 10\%$ $\frac{1}{2}$ W	01121	
R26	R: fxd comp 11K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R27	R: fxd comp 3K $\pm 5\%$ $\frac{1}{2}$ W	01121	
R28	R: fxd comp 62K $\pm 5\%$ $\frac{1}{2}$ W	01121	

Q1,2,3,5,6,7 2N4354
 Q4,8,9 2N3567
 Q10,11 2N4356
 Diodes 1N457

TTS 66-1A

Section 6

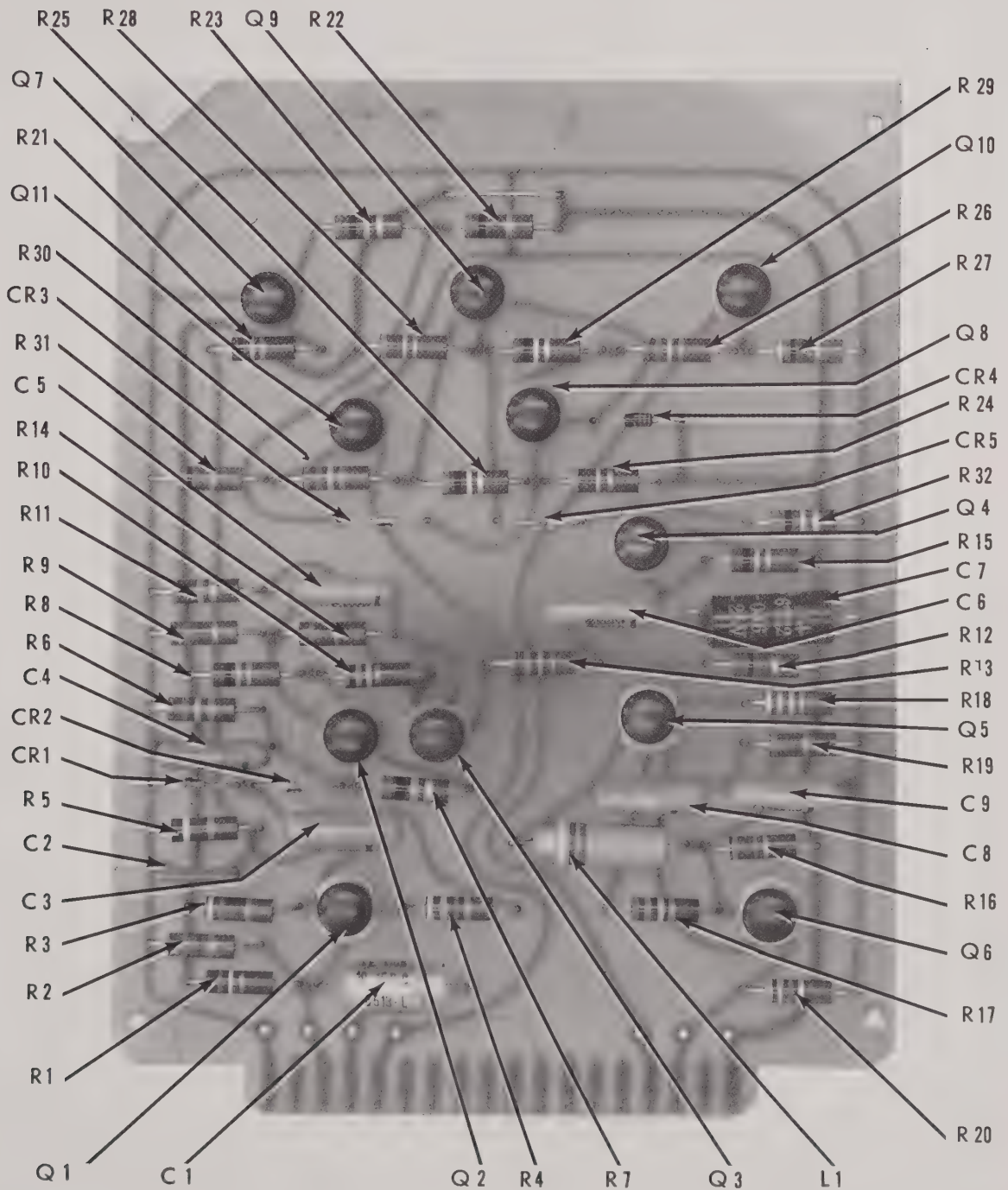


Fig. 6-7 E95261 Hookswitch Sequence Detector

**INSTRUCTION MANUAL
FOR
MODEL TTS 66-2
TRANSMISSION TEST SET**



NORTHEAST ELECTRONICS CORPORATION

P. O. BOX 649 — CONCORD, N. H. 03301

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SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL

1.2 The TTS 66-2 Transmission Test Unit consists of a circuit panel and an acoustic chamber, which in conjunction with the TTS 66-C Control Unit, provide for testing the transmission characteristics of a telephone set. The telephone set is placed in the acoustic chamber, which retains it in the position normally used by the subscriber.

1.3 The transmitter of the telephone is tested for GOOD or DEFECTIVE by transmitting "white noise" from an artificial mouth in the acoustic chamber into the transmitter and measuring the signal level appearing at the line cord through a C message filter. The handset and line cord may be tested for noise (intermittent breaks) by moving them at their point of connection to the telephone and observing the DEF lamp.

1.4 The receiver of the telephone is tested by transmitting "white noise" into the line cord and measuring the output from an artificial ear which is coupled to the receiver portion of the handset in the acoustic chamber.

1.5 The side tone of the telephone is tested by transmitting "white noise" from the artificial mouth and measuring the output of the artificial ear.

1.6 The output level of the "white noise" generator, limits for GOOD and DEFECTIVE, and the gain of the level measuring circuits is adjustable.

1.7 A four-position switch permits the switching of attenuation pads so as to nor-

malize the test results of the telephones of different manufacturers.

1.8 SPECIFICATIONS

TRANSMITTER TEST

- a. Lamps indicate GOOD or DEFECTIVE.
- b. Output level limits adjustable over 20 dB range.
- c. Accuracy ± 1 dB.
- d. Set type adjustable over 15 dB range.

RECEIVER TEST

- a. Lamps indicate GOOD or DEFECTIVE.
- b. Output level limits adjustable over 20 dB range.
- c. Accuracy ± 1 dB.
- d. Set type adjustable over 15 dB range.

SIDE TONE TEST

- a. Lamps indicate GOOD or DEFECTIVE.
- b. Output level limits adjustable over 20 dB range.
- c. Accuracy ± 1 dB.
- d. Set type adjustable over 15 dB range.

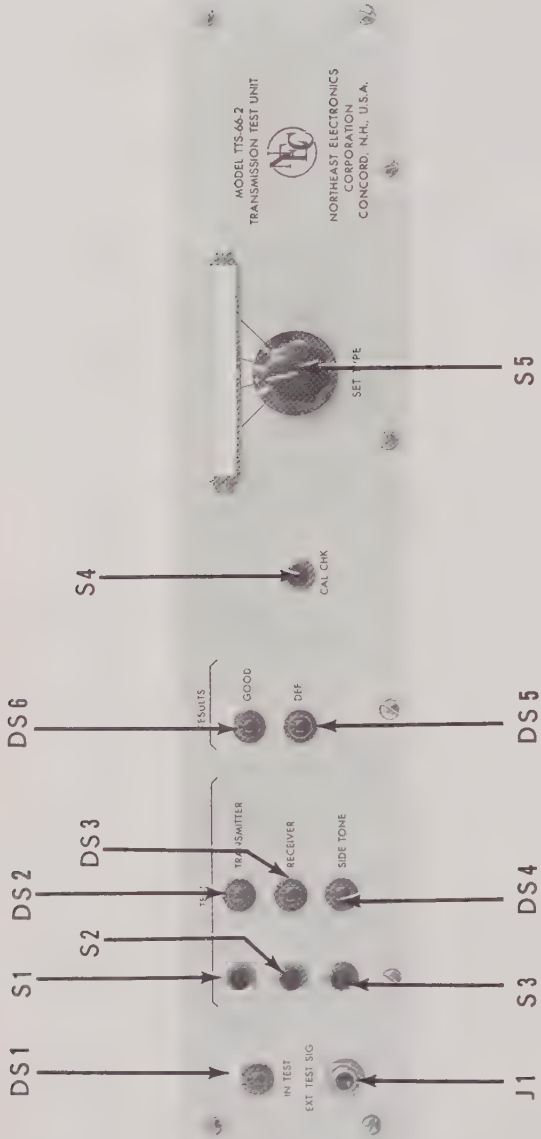


Figure 2-1 Front Panel Controls

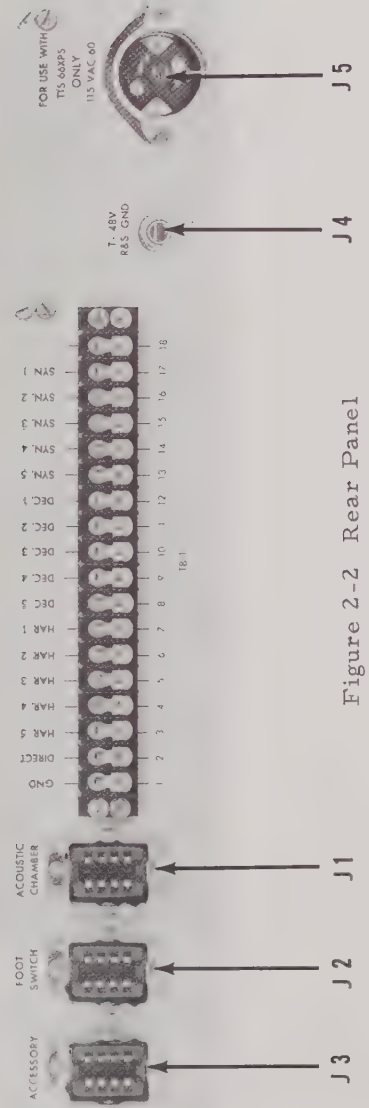


Figure 2-2 Rear Panel

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS. The table below locates and describes the front panel controls for the TTS 66-2 unit. (Refer to Fig. 2-1).

Name of Control	Ref Desig.	Type of Control	Use or Purpose
IN TEST lamp	DS1	Indicator	Indicates set is prepared for transmission testing.
TEST pushbuttons	S1, S2, S3	Pushbutton switches	Used to test transmitter, receiver or side tone response.
TEST lamps	DS2, DS3 and DS4	Indicators	Indicate which test is being performed.
RESULTS GOOD DEF lamps	DS5 and DS6	Indicators	Indicate results of tests performed.
CAL CHK pushbutton	S4	Pushbutton switch	For self-checking Transmission Test Unit
SET TYPE switch	S5	4-position rotary switch	Used to select correct test signal levels for the telephone set under test.
EXT TEST SIG. jack	J1	Jack for 310 type plug	Used as input jack for external signals instead of the internal white noise generator.

2.2 PRELIMINARY PROCEDURE. Connect -48V dc to the jack on the rear panel (Fig. 2-2). If the test set contains the optional TTS 66XPS Power Supply, connect the power cord furnished between the connector and a source of 110-120V ac, 60 Hz. On the TTS 66-C Control Unit, set the POWER switch to ON.

NOTE

The low voltage power supply contained in the TTS 66-C requires a warm-up period of approximately 5 minutes before measurements or calibration

procedures can be performed.

2.3 Connect the acoustic chamber and foot switch to the rear of the test set. The chamber may be mounted on either side of the console.

2.4 The following checks may be made with or without a telephone set connected to the TTS 66-C Control Unit; this provides a quick check of the overall operation of the test set.

Section 2

Paragraphs 2.5 to 2.7

CONTROL	ACTION	RESULT
1. TEST SEQUENCE switch	Cycle through all positions	Observe that the respective IN TEST lamps operate
2. TEST SEQUENCE	Set to TRANSMISSION	
3. CAL CHK pushbutton	Depress and hold	Observe that the RESULTS GOOD lamp operates

2.5 Set the TEST SEQUENCE switch to REMOTE CONTROL.

NOTE

If the foot switch is not used, the TEST pushbuttons will have to be cycled through the different positions as each test is made.

2.6 Connect the telephone set cord to the L1, L2 and G terminals on the TTS 66-C.

NOTE

Before any telephone set may be tested, the TTS 66 Telephone Test Set must be normalized to accept the four types of telephone sets to be tested. The normalization procedure requires that a reference subscriber set (having "average" transmission responses for its particular type) is available for each type to be tested. Section 4 contains a method for the statistical determination of a reference set.

2.7 TRANSMISSION TESTS

- a. Turn the SET TYPE control to the correct positions for the type of telephone to be tested.
- b. Condition the transmitter of the telephone set to be tested by rotating

ing the handset in an arc of 180° both clockwise and counter-clockwise. Place the handset in the acoustic chamber with the earpiece FIRMLY PUSHED ALL THE WAY into the cup and the handle firmly in the saddle grip.

NOTE

Perform all transmission tests involving this handset within 30 seconds after conditioning the transmitter or repeat the entire test.

c. Note by the operation of the results lamps the condition of the transmitter.

d. Depress the right-hand foot switch and release. The TEST RECEIVER lamp will operate. Note by the operation of the RESULTS GOOD or DEF lamps, the condition of the receiver.

e. Depress the right-hand foot switch and release. The TEST SIDETONE lamp will operate. Note by the operation of one of the RESULTS GOOD or DEF lamps the condition with regard to sidetone.

NOTE

Ensure that not more than 30 seconds has elapsed for steps c through e or else repeat the steps.

SECTION 3

CIRCUIT DESCRIPTION

3.1 TRANSMISSION TEST UNIT. The TTS 66-2 unit, in conjunction with the TTS 66-2AC Acoustic Chamber, measures the transmission response of a telephone's transmitter, receiver and sidetone networks.

3.2 The line cord of the telephone set is connected to the L1 (J10) and L2 (J11) terminals, or the standard telephone jack (J14) on the TTS 66-C Control Unit. The handset is placed in the Acoustic Chamber, which couples the receiver to the Artificial Ear (AE) and positions the transmitter with respect to the Artificial Mouth (AM).

3.3 Transmitter, receiver and sidetone tests are sequentially energized by REMOTE advancing through steps 4, 5, and 6 of stepping switch RM, or with switches S1, S2 and S3, on TTS 66-C Control Unit when the SEQUENCE switch is set to TRANSMISSION.

3.4 DC current is supplied to the telephone set through resistors R8, R9 and inductor L1. Capacitor C2 serves to filter any ripple appearing on the -48V supply. The combination of capacitor C1, C3, resistors R5 and R6 and R7 and R10 provide the necessary impedances and levels for each of the tests and forms an approximate 900 Ω termination for the telephone set.

3.5 The internal test signal employed, consisting of weighted "white noise", appears across pins N and L of the Noise Generator, Card 1. Connecting an external signal source to jack J1 automatically disconnects the internal source. Either signal is monitored at TP1 on CB2.

3.6 Signal processing of the transmission response is as follows:

- a. The Preamplifier, Card 3, provides approximately 27 dB of amplification for the artificial ear (AE). Resistors R11, R12 and R13 form a variable attenuator in conjunction with switch

S6, which permits ± 10 dB of signal level adjustment to allow setting test parameters. The attenuator output can be monitored at TP2.

- b. The Signal next passes through Card 4, a 0 loss C message filter. The output of the filter can be monitored at TP3. Final amplification is provided by the Voltage Amplifier, Card 5, driving transformer T1 to yield a combined gain of 55 dB from TP3 to TP4. The SET TYPE controls R16 through R19, R26 through R29 and R34 through R37 permits signal level adjustment over a 15 dB range at each position of the SET TYPE switch S5. These controls provide for normalization of four different set type responses. Test points TP8, TP9, and TP10 are provided for monitoring these adjustments.

- c. The signal flow divides between the HIGH and LOW LEVEL LIMIT controls; R21 and R22, R31 and R32, R39 and R40, providing a ± 10 dB adjustment range. The high and low outputs can be monitored at TP6 and TP7, respectively.

- d. These outputs are applied to the Dual Threshold Detector, Card 2, which operates lamp DS5 if the level is within prescribed limits, or lamp DS6 if it is outside of these limits.

3.7 The signal flow for each of the tests is governed by relays K1 through K4, as follows:

- a. CAL CHK: Switch S4 energizes relay K4, which applies the output of the Noise Generator to the input of the Preamplifier through a fixed pad consisting of resistors R2, R3 and R4. The signal is processed in

Section 3
Paragraph 3.7

the normal manner to the output of transformer T1. At this point, the signal flow divides between the two fixed attenuators, resistors R14 and R15, R24 and R25, providing a 4 dB separation between the two inputs to the Dual Threshold Detector. Switch S4 (CAL CHK) enables the RESULTS lamps, DS5 and DS6, which will indicate the condition of the test circuitry. That is, if the Noise Generator output is of the proper level, and all the signal processing circuits are operating correctly, the GOOD lamp, DS6, will operate.

b. TRANSMITTER: When energized, relay K1 connects the test signal to the Artificial Mouth. The resulting transmitter output, appearing across L1 and L2, is routed through resistor R6 and R7 (on CB2) and is extended through contacts of relay K1 to the CALIBRATE network. After filtering and final amplification, the signal is routed through the SET TYPE control (R16, R17, R18 or R19); the LEVEL

LIMIT controls (R21 and R22); and is extended via contacts of relays K1, K2 and K3 to the Dual Threshold Detector.

c. RECEIVER: When energized, relay K2 extends the test signal through resistors R5 and R6 to the telephone line cord via L1. The acoustic output of the receiver is air-coupled to the Artificial Ear, which applies a signal to the Preamplifier input. The processed signal is routed through resistors R26, R27, R28 or R29, R31 and R32, then via contacts of relays K2 and K3, to the Dual Threshold Detector.

d. SIDETONE: When energized, relay K3 connects the test signal to the Artificial Mouth and the resulting sidetone response produced at the receiver is air-coupled to the Artificial Ear, which applies a signal to the Preamplifier. The processed signal is routed through resistors R34, R35, R36 or R37, R39 and R40; then via contacts of relay K3 to the Dual Threshold Detector.

SECTION 4

CALIBRATION & MAINTENANCE

4.1 STATISTICAL DETERMINATION OF A
REFERENCE SET

4.2 TRANSMITTER

- a. Select any set from a group of the required type and connect it to the L1 and L2 terminals of the TTS 66-C.
- b. Slide the TTS 66-2 far enough out of the console to be able to reach the CALIBRATE (DB) control. Set to 0.
- c. Condition the transmitter of the telephone set by rotating the handset in an arc of 180° both clockwise and counter-clockwise.
- d. Place the handset in the acoustic chamber with the earpiece firmly pushed all the way into the cup and the handle firmly in the saddle grip.
- e. Set the SET TYPE control to the #1 position (extreme left) and connect a VTVM between TP8 (T) and TP5 (COM).
- f. Depress and hold TEST/TRANSMITTER pushbutton and adjust potentiometer R16 for a meter indication of 0.3 Vrms.
- g. Adjust the CALIBRATE (DB) control in a clockwise direction until the RESULTS lamps show threshold between GOOD and DEF. Record the CALIBRATE (DB) setting.
- h. Repeat steps c through g for a sufficiently large number of telephone sets. Plot the results obtained to determine the set that most nearly represents the average transmitter response.

- i. Using the reference set as determined above, return the CALIBRATE (DB) control to OPERATE and repeat steps e and f.

4.3 RECEIVER

- a. Select any set from a group of the required type and connect it to L1 and L2 terminals of the TTS 66-C.
- b. Slide the TTS 66-2 far enough out of the console to be able to reach the CALIBRATE (DB) control. Set to 0.
- c. Condition the receiver of the telephone set by rotating the handset in an arc of 180° both counter-clockwise and clockwise.
- d. Place the handset in the acoustic chamber with the earpiece firmly pushed all the way into the cup and the handle firmly in the saddle grip.
- e. Set the SET TYPE control to the #1 position (extreme left) and connect a VTVM between TP9 (R) and TP5 (COM).
- f. Depress and hold TEST/RECEIVER pushbutton and adjust potentiometer R16 for meter indication of 0.3 Vrms.
- g. Adjust the CALIBRATE (DB) control in a clockwise direction until the RESULTS lamps show threshold between GOOD and DEF. Record the CALIBRATE (DB) setting.
- h. Repeat steps c through g for a sufficiently large number of the sets.

Section 4

Paragraphs 4.3 to 4.10

Plot the results obtained to determine the set that most nearly represents the average receiver response.

i. Using the reference set as determined above, return the CALIBRATE (DB) control to OPERATE and repeat steps e and f.

4.4 SIDETONE

a. Select any set from a group of the required type and connect it to L1 and L2 terminals of the TTS 66-C.

b. Slide the TTS 66-2 far enough out of the console to be able to reach the CALIBRATE (DB) control. Set to 0.

c. Condition the sidetone of the telephone set by rotating the handset in an arc of 180° both clockwise and counter-clockwise.

d. Place the handset in the acoustic chamber with the earpiece firmly pushed all the way into the cup and the handle firmly in the saddle grip.

e. Set the SET TYPE control to the #1 position (extreme left) and connect a VTVM between TP10 (ST) and TP5 (COM).

f. Depress and hold TEST/SIDETONE pushbutton and adjust potentiometer R16 for meter indication of 0.3 Vrms.

g. Adjust the CALIBRATE (DB) control in a clockwise direction until the RESULTS lamps show threshold between GOOD and DEF. Record the CALIBRATE (DB) setting.

h. Repeat steps c through g for a sufficiently large number of sets. Plot the results obtained to determine the set that most nearly represents the average sidetone response.

i. Using the reference set as deter-

mined above, set the CALIBRATE (DB) control to OPERATE and repeat steps e and f.

4.5 Enter the type of telephone on the marker above position 1 of the SET TYPE switch. Repeat the above procedure for each additional type of telephone to be tested, with the following substitutions as required:

For	Substitute			
SET TYPE; pos 1	pos 2	3	4	
R16	R17	R18	R19	
R26	R27	R28	R29	
R34	R35	R36	R37	

4.6 CALIBRATION. The following calibration procedures should be carried out periodically to ensure that the parameters of the set remain within their specified limits.

4.7 TEST EQUIPMENT REQUIRED:

AC Voltmeter. Hewlett Packard 400FL or equivalent

4.8 PRELIMINARY PROCEDURE. To operate the test set on office battery, plug a tip and ring cord (type 310) into the jack on the rear panel (fig. 2-2). If the test set contains the optional TTS 66XPS Power Supply, connect the power cord furnished between the connector and a source of 110-120Vac 50/60 Hz. On the TTS 66-C Control Unit set the POWER switch to ON.

NOTE

The low voltage power supply contained in the TTS 66-C requires a warm-up period of approximately five minutes before measurements or calibration procedures can be performed.

4.9 Connect the acoustic chamber and foot switch to the rear of the test set. The chamber may be mounted on either side of the console.

4.10 The following checks may be made with

or without a telephone set connected to the TTS 66-C Control Unit.

CONTROL	ACTION	RESULT
1. TEST SEQUENCE switch	Cycle through all positions.	Observe that the respective IN TEST lamps operate.
2. TEST SEQUENCE	Set to TRANSMISSION.	
3. CAL CHK pushbutton	Depress and hold.	Observe that the RESULT GOOD lamp operates.

4.11 TRANSMISSION TEST UNIT CALIBRATION.

NOTE

The transmitter current is factory set at 36 mA. To change this setting, insert milliammeter in series with telephone connection to L1 or L2 and adjust R8 (DC mA) for desired current value.

a. Slide the TTS 66-2 unit out of the console far enough to be able to see the controls and their accompanying legend.

b. Connect a reference telephone set to the L1 and L2 terminals on the TTS 66-C.

4.12 LEVEL LIMIT ADJUSTMENTS

4.13 TRANSMITTER TESTS. Perform the checks and adjustments in the following sequence.

CONTROL	ACTION	RESULT
1.	Condition and place handset in acoustic chamber.	
2. CALIBRATE (DB) control	Set to OPERATE	
3. R21 and R22 HI and LO LEVEL LIMIT Controls	Set R21 fully CCW. Set R22 fully CW.	
4.	Connect AC Voltmeter between TP8 and TP5.	
5. TEST TRANSMITTER pushbutton	Depress button and adjust R16, R17, R18 or R19 for correct result.	Meter should read 0.3 volts rms at TP8 and RESULTS GOOD lamp operates.
6. CALIBRATE (DB) control	Set to desired low level limit (settings are in dB).	
7. R22, LO LEVEL control	Depress TEST TRANSMITTER button and adjust R22 in a counter-clockwise direction until proper result is obtained.	RESULTS lamps should indicate a threshold between GOOD and DEF.

Section 4

Paragraph 4.14

	CONTROL	ACTION	RESULTS
8.	CALIBRATE (DB) control.	Set to desired high level limit.	
9.	R21, HI LEVEL LIMIT control	Depress TEST TRANSMITTER button and adjust R21 in a clockwise direction until proper result is obtained.	RESULTS lamps should indicate a threshold between GOOD and DEF.
10.	CALIBRATE (DB) control.	Set control to OPERATE.	

4.14 RECEIVER TESTS. Perform the checks and adjustments in the following sequence:

	CONTROL	ACTION	RESULTS
1.		Condition and place handset in the acoustic chamber.	
2.	CALIBRATE (DB) control.	Set to OPERATE.	
3.	R31 and R32 HI and LO LEVEL LIMIT Controls	Set R31 fully CCW. Set R32 fully CW.	
4.		Connect AC Voltmeter between TP9 and TP5.	
5.	TEST RECEIVER pushbutton	Depress button and adjust R26, R27, R28 or R29 for correct result.	Meter should read 0.3 volts rms at TP9 and RESULTS GOOD lamp operates.
6.	CALIBRATE (DB) control	Set to desired low level limit (settings are in dB).	
7.	R32, LO LEVEL control	Depress TEST RECEIVER button and adjust R32 in a counterclockwise direction until proper result is obtained.	RESULTS lamps should indicate a threshold between GOOD and DEF.
8.	CALIBRATE (DB) control	Set to desired high level limit.	
9.	R31, HI LEVEL LIMIT control	Depress TEST RECEIVE button and adjust R31 in a clockwise direction until proper result is obtained.	RESULTS lamps should indicate a threshold between GOOD and DEF.
10.	CALIBRATE (DB) control.	Set control to OPERATE.	

4.15 SIDETONE TESTS. Perform the checks and adjustments in the following sequence:

CONTROL	ACTION	RESULTS
1.	Condition and place handset in the acoustic chamber.	
2. CALIBRATE (DB) control	Set to OPERATE.	
3. R39 and R40 HI and LO LEVEL LIMIT Controls	Set R39 fully CCW. Set R40 fully CW.	
4.	Connect AC Voltmeter between TP10 and TP5.	
5. TEST SIDETONE pushbutton	Depress button and adjust R34, R35, R36 or R37 for correct result.	Meter should read 0.3 volts rms at TP10 and RESULTS GOOD lamp operates.
6. CALIBRATE (DB) control	Set to desired low level limit (settings are in dB).	
7. R40, LO LEVEL LIMIT control	Depress TEST SIDETONE button and adjust R40 in a counter-clockwise direction until proper result is obtained.	RESULTS lamps should indicate a threshold between GOOD and DEF.
8. CALIBRATE (DB) ~~control.~~	Set to desired high level limit.	
9. R39, HI LEVEL LIMIT control ~~control~~	Depress TEST SIDETONE button and adjust R39 in a clockwise direction until proper result is obtained.	RESULTS lamps should indicate a threshold between GOOD and DEF.
10. CALIBRATE (DB) control.	Set control to OPERATE.	

4.16 At the completion of the checks in the preceding paragraphs, ensure that the CALIBRATE (DB) control is returned to the OPERATE position.

4.17 MAINTENANCE INSTRUCTIONS. In the event of a malfunction in the operation of the sets, the following simple checks should be performed before attempting more detailed troubleshooting.

- a. Check to see that the power connection on the rear panel is correctly

connected to the proper external power source:

1. DC (office battery): 44-52 Vdc, tip negative, ring or sleeve positive:

or

2. AC (for use only when equipped with TTS 66XPS or PS101R regulated 48V power supply): 115V ac, 50/60 Hz.

Section 4

Paragraphs 4.18 and 4.19

b. Check that all fuses are installed and are of the specified type and rating.

c. Check that all interconnecting plugs are fully mated with the correct receptacles on the rear of the TTS 66-C Control Unit and rear panel.

4.18 If the malfunction is not cleared during the previous steps, proceed as follows with POWER switch in the OFF position.

a. Completely remove the affected unit from the console by removing the four front panel screws and carefully sliding the unit forward and out. The interconnecting cable will be long enough to allow the unit to be placed on the bench adjacent to the console without disengaging.

b. The plug-in component boards should be removed with the extractor key, pulling straight back until the guides are cleared.

c. Perform a visual inspection of the unit, looking for broken or shorted wires, damaged components and

other obvious faults.

d. Check to be sure all plug-in boards are in their correct locations and are fully engaged.

e. Check that all plug-in components (including lamps) are fully engaged in their respective sockets.

f. Check operation of panel switches; noting that they operate freely. Visually inspect contacts to ensure positive electrical connections. If required, clean contacts with a good contact cleaner.

4.19 DC POWER DISTRIBUTION

a. Unless otherwise indicated, all voltages are referred to "ground". Connections to ground can always be made to either Pin #1 on all interconnecting plugs and sockets or Pin A of plug-in component cards.

b. With POWER switch set to ON, select the desired test and measure the appropriate dc voltage in accordance with Table 4-1.

Table 4-1 Test Voltages

TEST SELECTED	CONTROL OPERATED	-44 to -52 Vdc		-21 to -24 Vdc	
		Card or Plug	Pin #	Card or Plug	Pin #
TRANSMISSION	NONE	P-7	2	P-7	3
TRANSMISSION	TRANSMITTER	P-7	5	-	-
TRANSMISSION	RECEIVER	P-7	6	-	-
TRANSMISSION	SIDETONE	P-7	7	-	-

4.20 Transmission Test Unit (TTS 66-2)

- a. The calibration of the transmission measuring circuit should be checked with a high impedance RMS indicating ac voltmeter
- b. Set the TEST SEQUENCE switch to TRANSMISSION and the internal CAL CONTROL to OPERATE.
- c. For each point indicated, depress the CAL CHECK switch and adjust for the specified voltage.

NOTE

It will be necessary to use the extender card (located beneath Card 5) in order to adjust cards 3 and 5.

Adjustment Located On	Test Point	Reading (RMS)
Card 1 (Noise Generator)	1	$0.62 \pm 0.02V$
3	2	$0.005 \pm 0.0002V$
	3	0.005 ± 0.0002
5	4	$2.5V \pm 0.1V$

SECTION 5

SCHEMATIC DIAGRAMS

5.1 INTRODUCTION. The following pages contain the schematic diagrams for the TTS 66-2 Transmission Test Unit. Wherever possible all the information is contained on one diagram, however because of limitations in printing, some of the individual printed circuit boards are illustrated on separate sheets.

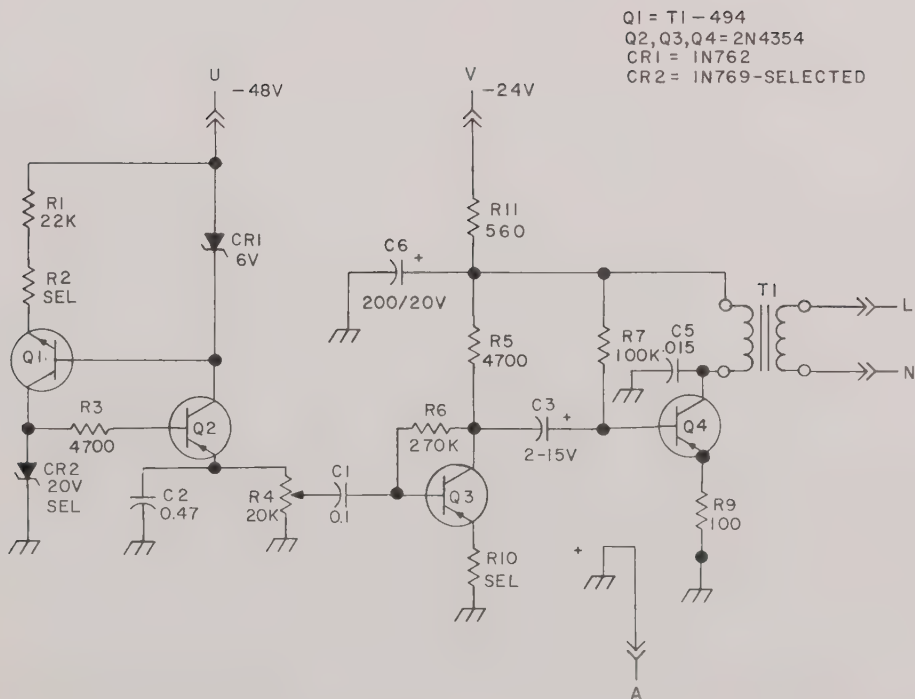


Figure 5-1 Noise Generator - Card #1

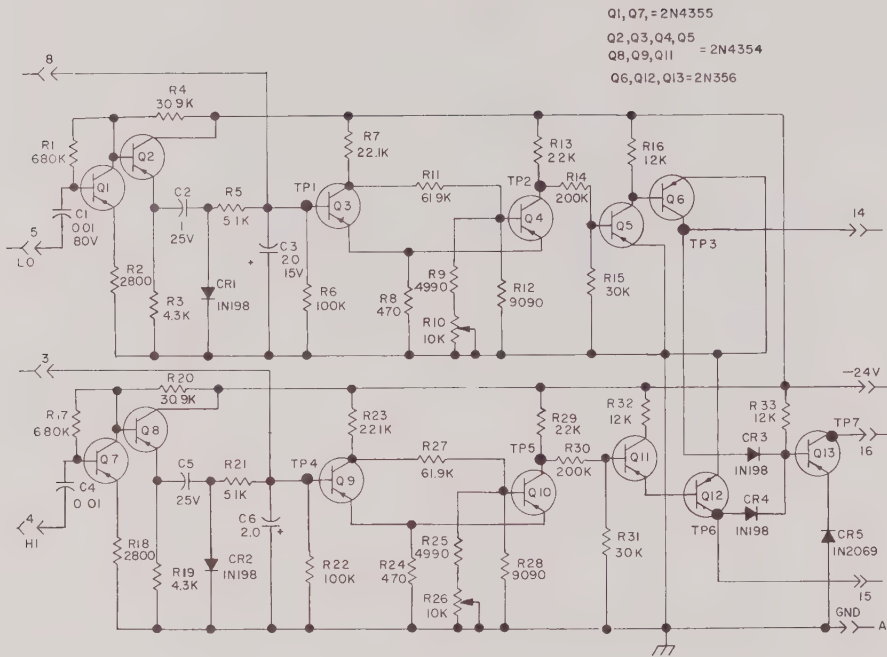


Figure 5-2 Dual Threshold Detector - Card #2

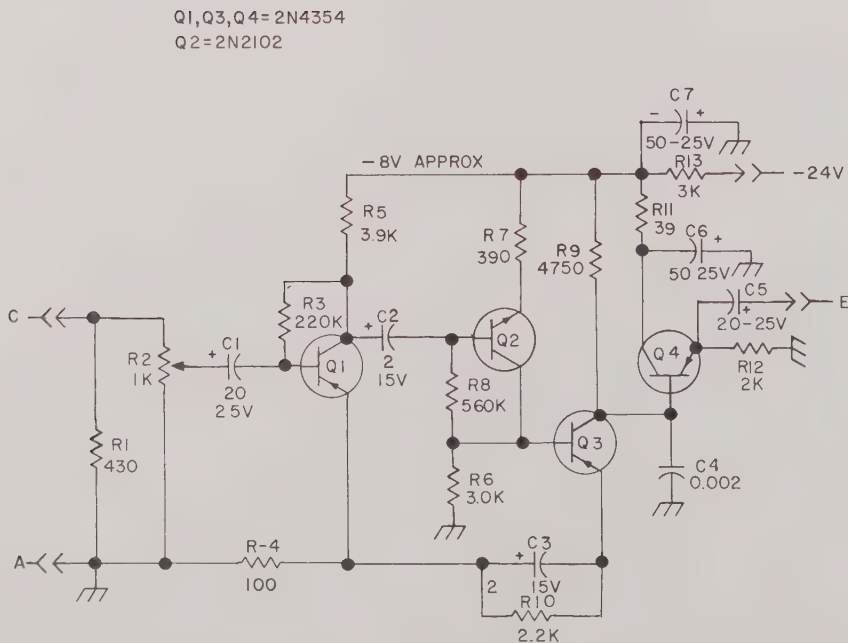


Figure 5-3 Preamplifier - Card #3

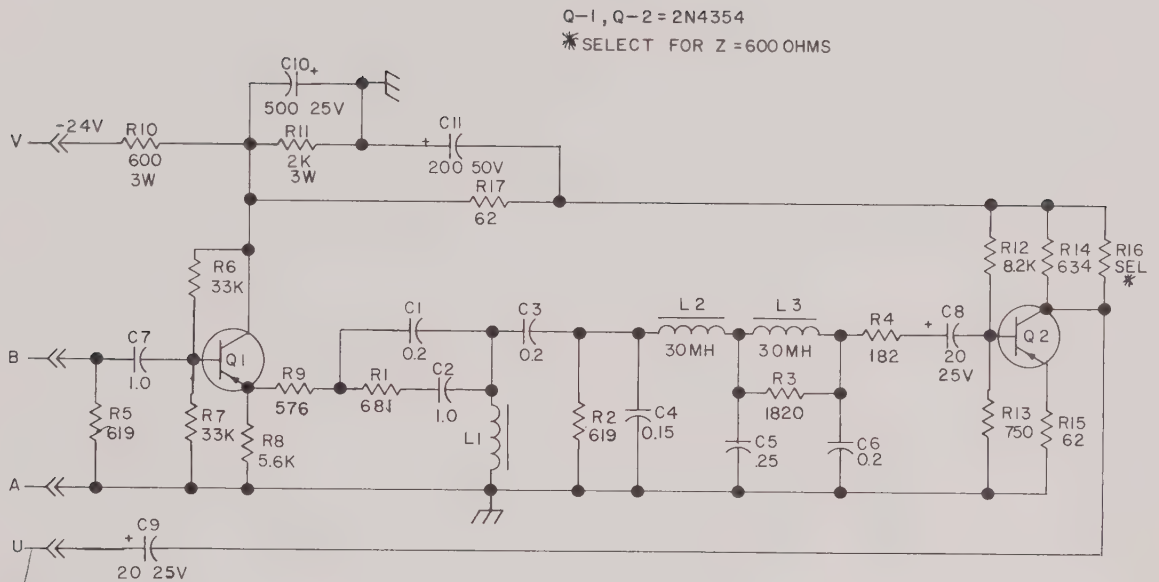


Figure 5-4 C-Message Filter - Card #4

*continuity
Pm 1-10-C*

Q1, Q3 = 2N4354 PNP
Q2 = 2N2102 NPN
Q4 = 2N4355 PNP

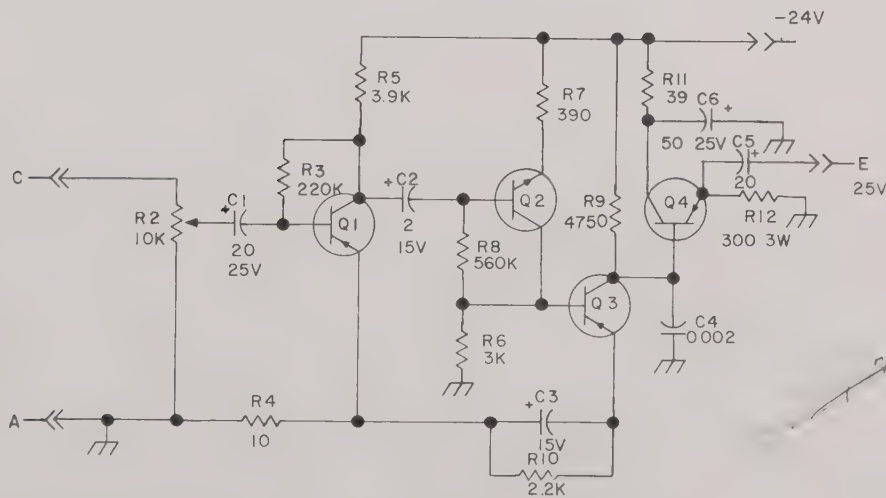


Figure 5-5 Voltage Amplifier - Card #5

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 66-2 Transmission Test Unit.

6.2 FSCM Code Numbers. This is the Federal Supply Code of Manufacturers as issued Sept. 1968. A list of codes and their respective manufacturers is given below.

LIST OF MANUFACTURERS

Code No.	Manufacturer
01121	Allen Bradley
04221	Aemco
04773	Automatic Electric
06288	Edal
07716	IRC
09653	C&K
12065	Transitron
12697	Clarostat
13606	Sprague
17803	Fairchild
24433	M. S. Transistor
49671	RCA
71590	Centralab
78957	Stromberg-Carlson
80368	Sylvania
81073	Grayhill
82389	Switchcraft
82877	Rotron
90201	Mallory
94696	Magnecraft

6.3 List of abbreviations used in parts list.

C - capacitor	R - resistor
S - switch	Pot - potentiometer
Ind - inductor	ww - wirewound
elect - electrolytic	comp - composition
mf - metal film	ppr - paper

Section 6

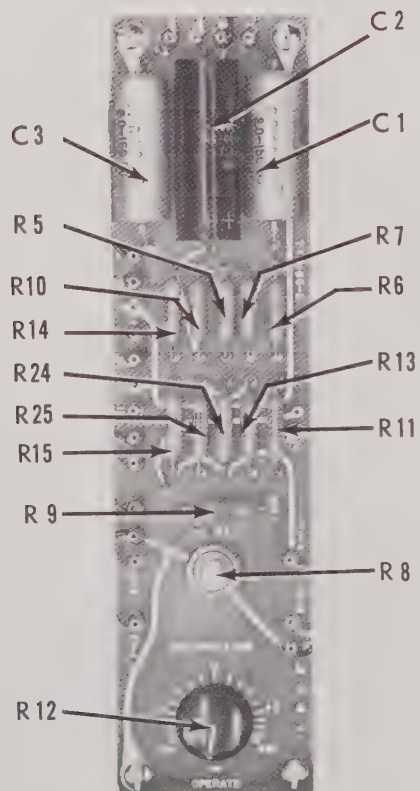
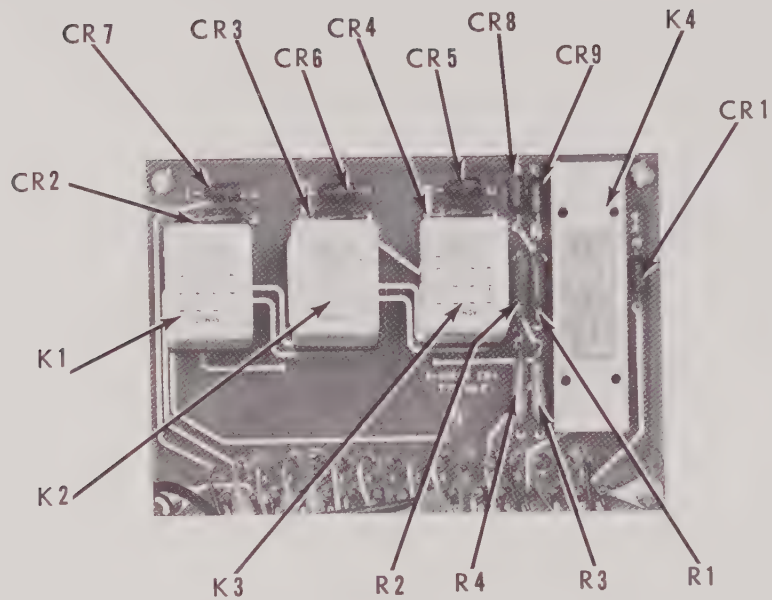


Figure 6-1 CB1 and CB2 - Component Location

CB1

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
CR1 thru CR8	Diodes: silicon	80368	1N2069
K1 thru K3	Relays: 4C	04221	156-4023
K4	Relay: 1000 Ω coil	94696	W103MPCX-4
R1	R: fxd ww 1.0K 5% 3W	01121	
R2	R: fxd mf sel val 1% $\frac{1}{2}$ W	07716	CECTO
R3	R: fxd mf 383 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R4	R: fxd mf 300 Ω 1% $\frac{1}{2}$ W	07716	CECTO

CB2

C1	C: fxd ppr 2 μ F 150V	13606	121P2
C2	C: fxd elect 200 μ F 50V	09653	APS-217
C3	C: fxd ppr 2 μ F 150V	13606	121P2
R5	R: fxd mf 274 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R6	R: fxd mf 715 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R7	R: fxd comp 60 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R8	R: var ww 2500 Ω 5W	94696	WN2521
R9	R: fxd ww 100 Ω 10% 1W	01121	
R10	R: fxd mf 50 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R11	R: fxd mf sel val		
R12	R: var ww 2500 Ω	12697	
R13	R: fxd mf 240 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R14	R: fxd mf 755 Ω 1% $\frac{1}{2}$ W	07716	CECTO
R15	R: fxd mf 32.4K 1% $\frac{1}{2}$ W	07716	CECTO
R24	R: fxd mf 32.4K 1% $\frac{1}{2}$ W	07716	CECTO
R25	R: fxd mf 1200 Ω 1% $\frac{1}{2}$ W	07716	CECTO

CB3

R16 thru R19	R: var comp 50K	90201	MTC-4
R20	R: fxd mf 26.7K 1% $\frac{1}{2}$ W	07716	CECTO
R21 and R22	R: var comp 10K	90201	MTC-4
R23	R: fxd mf 3.01K 1% $\frac{1}{2}$ W	07716	CECTO
R26 thru R29	R: var comp 50K $\frac{1}{2}$ W	90201	MTC-4
R30	R: fxd mf 26.7K 1% $\frac{1}{2}$ W	07716	CECTO
R31 and R32	R: var comp 10K	90201	MTC-4
R33	R: fxd mf 3.01K 1% $\frac{1}{2}$ W	07716	CECTO
R34 thru R37	R: var comp 50K	90201	MTC-4
R38	R: fxd mf 3.01K 1% $\frac{1}{2}$ W	07716	CECTO
R39 and R40	R: var comp 10K	90201	MTC-4
R41	R: fxd mf 3.01K 1% $\frac{1}{2}$ W	07716	CECTO

Main Assembly

DS1 thru DS6	Lamps: 60V	80368	60A
Card # 1	Noise Generator: PC bd. complete	06819	E95116
Card # 2	Dual Threshold Detector: PC bd. complete	06819	E95146
Card # 3	Preamplifier: PC bd. complete	06819	E95127
Card # 4	C Msg. Filter: PC bd. complete	06819	E95123

Main Assembly (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
Card #5	Voltage Amplifier: PC Bd. complete	06819	E95127
J1	Jack: telephone	82389	C55B-SF
L1	Inductor	04773	274J
S1 thru S4	S: pushbutton	82389	913
S5	S: rotary 4 pole 6 pos	71590	PA2011
T1	Transformer		T31-X
TTS 66-2AC	A.M. - Artificial Mouth	78957	211881
TTS 66-2AC	A.E. - Artificial Ear	82872	ANB-H-1
	Extender Card	06819	E95079

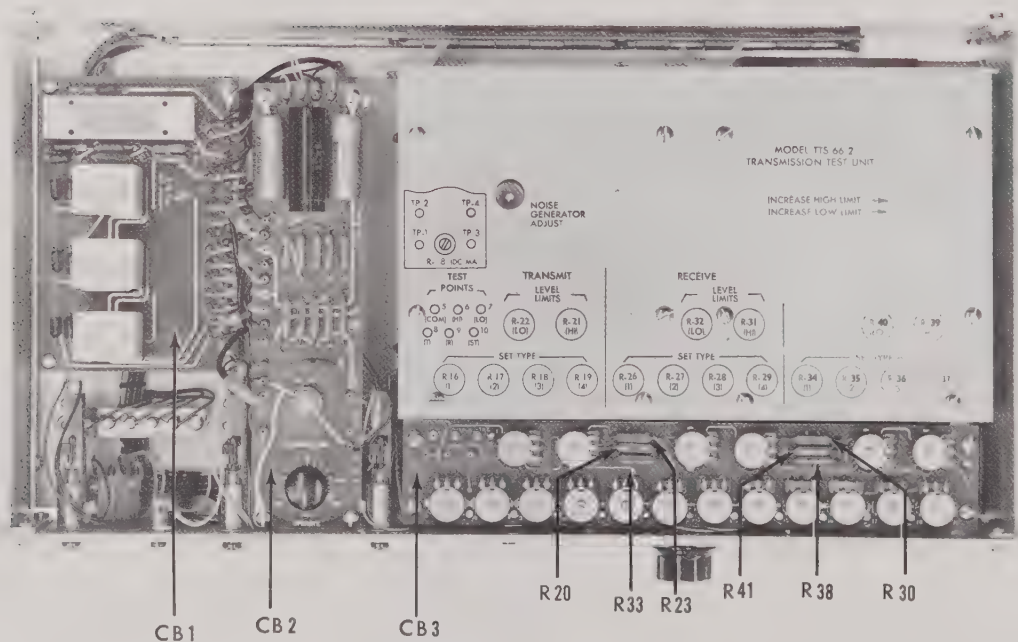


Fig. 6-2 TTS 66-2 Top View and CB3 Component location

NOISE GENERATOR (CARD 1)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd flm 0.1 μ F	13606	225P
C2	C: fxd flm 0.047 μ F	13606	225P
C3	C: fxd elect 2 μ F 15V	13606	TE1149
C4	C: not used		
C5	C: fxd flm 0.015 μ F	13606	225P
C6	C: fxd elect 200 μ F 20V	09653	APD-115
R1	R: fxd comp 22K Ω $\frac{1}{2}$ W 10%	01121	
R2	R: fxd comp sel val $\frac{1}{2}$ W 10%	01121	
R3	R: fxd comp 4700 Ω $\frac{1}{2}$ W 10%	01121	
R4	R: var comp 20K	90201	
R5	R: fxd comp 4700 Ω $\frac{1}{2}$ W 10%	01121	
R6	R: fxd comp 270K $\frac{1}{2}$ W 10%	01121	
R7	R: fxd comp 100K $\frac{1}{2}$ W 10%	01121	
R8	R: not used		
R9	R: fxd comp 100 Ω $\frac{1}{2}$ W 10%	01121	
R10	R: fxd comp sel val $\frac{1}{2}$ W 10%	01121	
R11	R: fxd comp 560 Ω $\frac{1}{2}$ W 10%	01121	
CR1	Diode: zener 6V 10%	12065	1N762
CR2	Diode: zener 20V 10%	12065	1N769 (sel)
Q1	Transistor: NPN	24433	T1494
Q2 -4	Transistors: PNP	81073	2N4354
T1	Transformer	81095	TY-51X

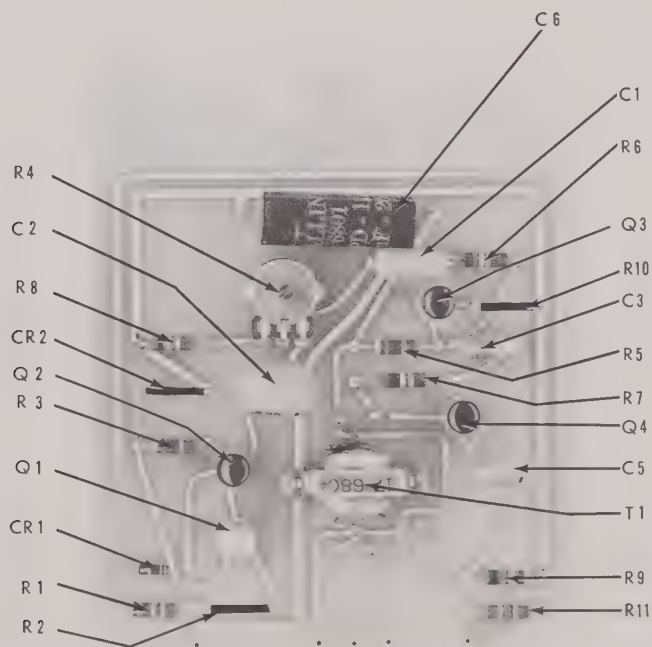


Figure 6-3 Component Location Card 1

DUAL THRESHOLD DETECTOR (CARD #2)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd film 0.01 μ F 80V	13606	225P
C2	C: fxd film 1.0 μ F 25V	13606	5C13
C3	C: fxd elect 2.0 μ F 15V	13606	TE1149
C4	C: fxd film 0.01 μ F 80V	13606	225P
C5	C: fxd film 1.0 μ F 25V	13606	5C13
C6	C: fxd elect 2.0 μ F 15V	13606	TE1149
R1	R: fxd comp 680K Ω 10% $\frac{1}{2}$ W	01121	
R2	R: fxd comp 2800 Ω 1% $\frac{1}{2}$ W	01121	
R3	R: fxd comp 4.3K $\frac{1}{2}$ W 10%	01121	
R4	R: fxd comp 30.75K $\frac{1}{2}$ W 1%	07716	CECTO
R5	R: fxd comp 5.1K $\frac{1}{2}$ W 10%	01121	
R6	R: fxd comp 100K $\frac{1}{2}$ W 10%	01121	
R7	R: fxd mf 22.1K $\frac{1}{2}$ W 1%	07716	CECTO
R8	R: fxd comp 470 Ω $\frac{1}{2}$ W 10%	01121	
R9	R: fxd mf 4990 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R10	R: var comp 10K	90201	MTC-4
R11	R: fxd mf 61.9K $\frac{1}{2}$ W 1%	07716	CECTO
R12	R: fxd mf 9.09 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R13	R: fxd comp 22K $\frac{1}{2}$ W 10%	01121	
R14	R: fxd comp 200K $\frac{1}{2}$ W 10%	01121	
R15	R: fxd comp 30K $\frac{1}{2}$ W 10%	01121	
R16	R: fxd comp 12K $\frac{1}{2}$ W 10%	01121	
R17	R: fxd comp 680K $\frac{1}{2}$ W 10%	01121	
R18	R: fxd mf 2800 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R19	R: fxd comp 4.3K $\frac{1}{2}$ W 10%	01121	
R20	R: fxd mf 30.75K $\frac{1}{2}$ W 1%	07716	CECTO
R21	R: fxd comp 5.1K $\frac{1}{2}$ W 10%	01121	
R22	R: fxd comp 100K $\frac{1}{2}$ W 10%	01121	
R23	R: fxd mf 22.1K $\frac{1}{2}$ W 1%	07716	CECTO
R24	R: fxd comp 470 Ω $\frac{1}{2}$ W 10%	01121	
R25	R: fxd mf 4990 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R26	R: var comp 10K	90201	MTC-4
R27	R: fxd mf 61.9K $\frac{1}{2}$ W 1%	07716	CECTO
R28	R: fxd mf 9.09 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R29	R: fxd comp 22K $\frac{1}{2}$ W 10%	01121	
R30	R: fxd comp 200K $\frac{1}{2}$ W 10%	01121	
R31	R: fxd comp 30K $\frac{1}{2}$ W 10%	01121	
R32	R: fxd comp 12K $\frac{1}{2}$ W 10%	01121	
R33	R: fxd comp 12K $\frac{1}{2}$ W 10%	01121	
Q1	Transistor: PNP	81073	2N4355
Q2 thru Q5	Transistors: NPN	81073	2N4354
Q6	Transistor: PNP	81073	2N4356
Q7	Transistor: PNP	81073	2N4355
Q8 thru Q11	Transistors: NPN	81073	2N4354
Q12 and Q13	Transistors: PNP	81073	2N4356
CR1 thru CR4	Diodes: germanium	80368	1N198
CR5	Diode: germanium	06288	1N2069

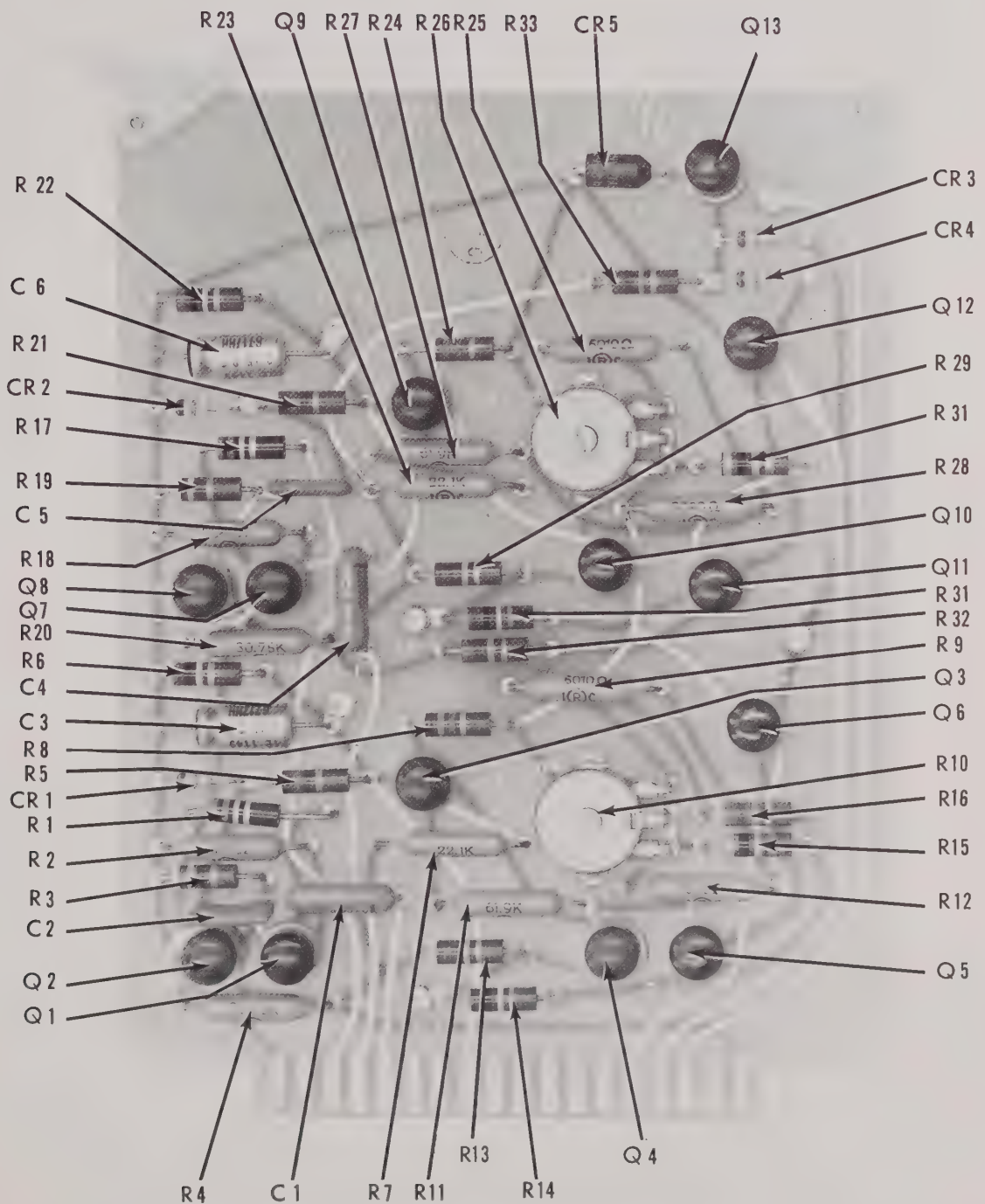


Figure 6-4 Component Location Card 2

Section 6

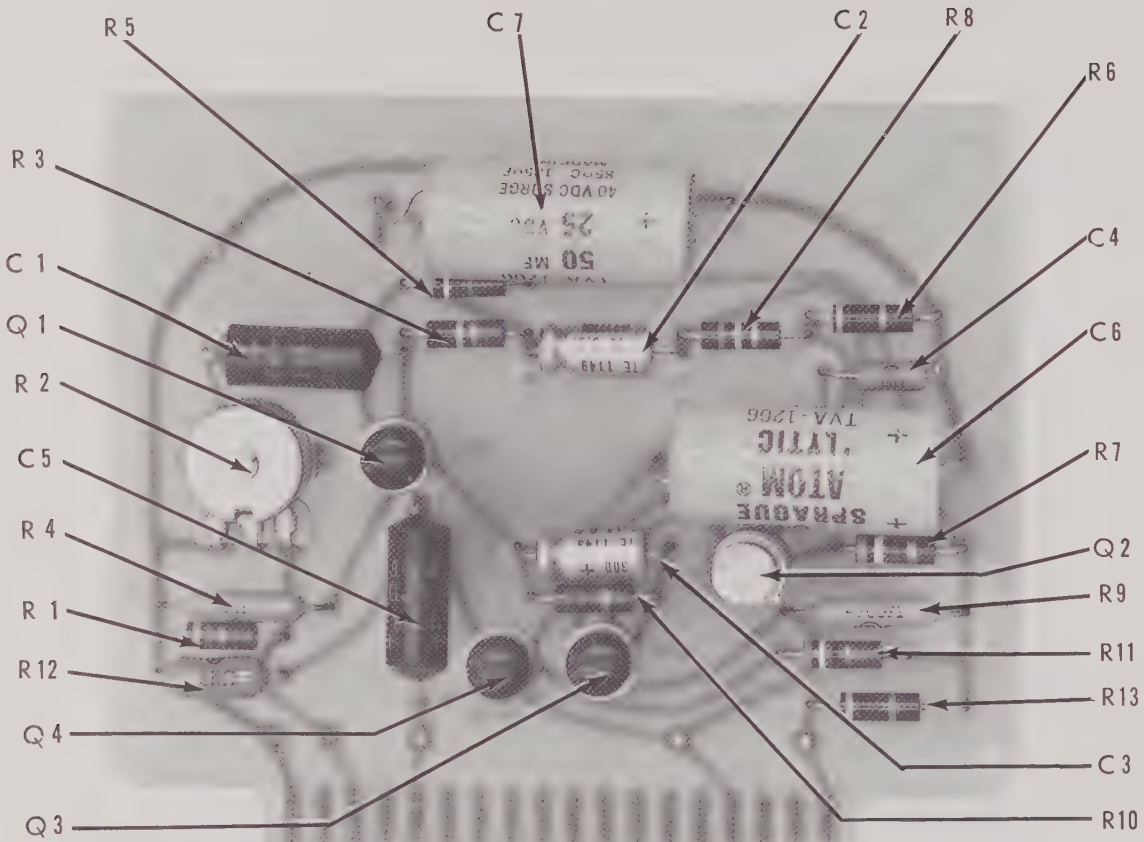


Figure 6-5 Component Location Card 3

PREAMPLIFIER

C1	C: fxd elect 20 μ F 25V	09653	APD046
C2	C: fxd elect 2 μ F 15V	13606	TE1149
C3	C: fxd elect 2 μ F 15V	13606	TE1149
C4	C: fxd flm 0.002 μ F	13606	225P
C5	C: fxd elect 20 μ F 25V	13606	TVA
C6 & C7	C: fxd elect 50 μ F 25V	13606	TVA
R1	R: fxd comp 430 Ω $\frac{1}{2}$ W 10%	01121	
R2	R: var comp 1K	90201	
R3	R: fxd comp 220K $\frac{1}{2}$ W 10%	01121	
R4	R: fxd mf 100 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R5	R: fxd comp 3.9K $\frac{1}{2}$ W 10%	01121	
R6	R: fxd comp 3K $\frac{1}{2}$ W 10%	01121	
R7	R: fxd comp 390 Ω $\frac{1}{2}$ W 10%	01121	
R8	R: fxd comp 560K $\frac{1}{2}$ W 10%	01121	
R9	R: fxd comp 4.7K $\frac{1}{2}$ W 1%	07716	CECTO
R10	R: fxd comp 2.2K $\frac{1}{2}$ W 10%	01121	
R11	R: fxd comp 39 Ω $\frac{1}{2}$ W 10%	01121	
R12	R: fxd comp 2K $\frac{1}{2}$ W 10%	01121	
Q1	Transistor: PNP	17803	2N4354
Q2	Transistor: NPN	17803	2N2102
Q3 - 4	Transistors: PNP	17803	2N4354

VOLTAGE AMPLIFIER (CARD #5)

Ref Desig	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd elect 20 μ F 25V	09653	APD-046
C2	C: fxd elect 2.0 μ F 15V	13606	TE1149
C3	C: fxd elect 2.0 μ F 15V	13606	TE1149
C4	C: fxd flm 0.002 μ F	13606	225P
C5	C: fxd elect 20 μ F 25V	09653	APD046
C6	C: fxd elect 50 μ F 25V	13606	TVA1308
R1	Not used		
R2	R: var comp 10K	90201	
R3	R: fxd comp 220K $\frac{1}{2}$ W 10%	01121	
R4	R: fxd mf 10 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R5	R: fxd comp 3.9K $\frac{1}{2}$ W 10%	01121	
R6	R: fxd comp 3.0K $\frac{1}{2}$ W 10%	01121	
R7	R: fxd comp 390 Ω $\frac{1}{2}$ W 10%	01121	
R8	R: fxd comp 560K $\frac{1}{2}$ W 10%	01121	
R9	R: fxd comp 4.7K $\frac{1}{2}$ W 1%	07716	CECTO
R10	R: fxd comp 2.2K $\frac{1}{2}$ W 10%	01121	
R11	R: fxd comp 39 Ω $\frac{1}{2}$ W 5%	01121	
R12	R: fxd comp 300 Ω 3W 10%	07716	CECTO
Q1-2	Transistors: PNP	17803	2N4354
Q3	Transistor: NPN	49671	2N2102
Q4	Transistor: PNP	17803	2N4355

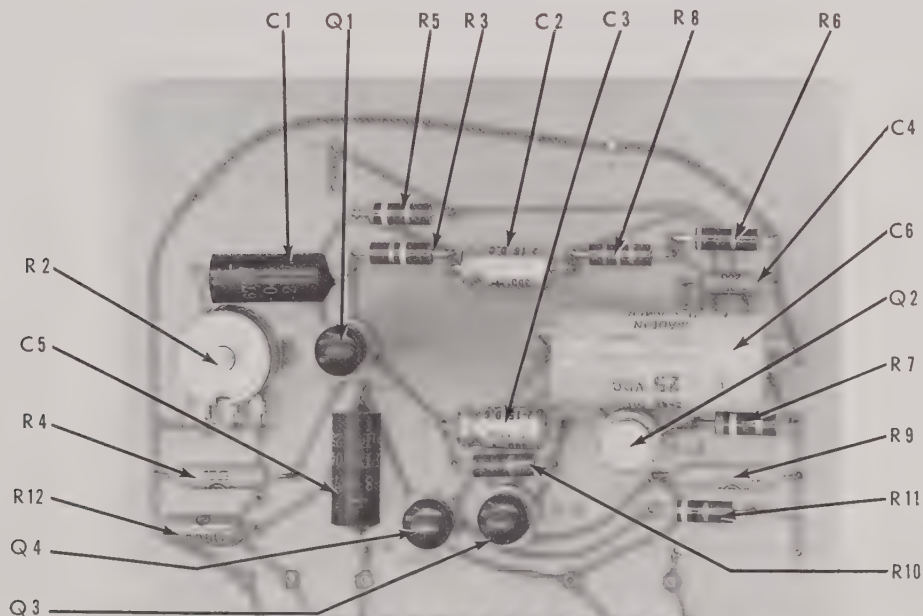


Figure 6-6 Component Location Card 5

Section 6

C-MSG FILTER (CARD #4)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: fxd 0.2 μ F 200V	13606	P8292ZN13
C2	C: fxd 1.0 μ F 200V	13606	
C3	C: fxd 0.2 μ F 200V	13606	
C4	C: fxd 0.15 μ F 200V	13606	
C5	C: fxd 0.25 μ F 200V	13606	P8292ZN13
C6	C: fxd 0.2 μ F 200V	13606	
C7	C: fxd 1.0 μ F 200V	13606	
C8	C: fxd elect 20 μ F 25V	13606	
C9	C: fxd elect 20 μ F 25V	13606	TE1305
C10	C: fxd elect 500 μ F 25V	13606	TE1305
C11	C: fxd elect 200 μ F 50V	13606	TVA 1219
R1	R: fxd mf 680 Ω $\frac{1}{2}$ W 1%	07716	TVA
R2	R: fxd mf 620 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R3	R: fxd mf 1.8K $\frac{1}{2}$ W 1%	07716	CECTO
R4	R: fxd mf 183.7 $\frac{1}{2}$ W 1%	07716	CECTO
R5	R: fxd mf sel val $\frac{1}{2}$ W 1%	07716	CECTO
R6	R: fxd comp 33K $\frac{1}{2}$ W 10%	01121	CECTO
R7	R: fxd comp 33K $\frac{1}{2}$ W 10%	01121	
R8	R: fxd comp 5.6K $\frac{1}{2}$ W 10%	01121	
R9	R: fxd mf 580 Ω $\frac{1}{2}$ W 1%	07716	
R10	R: fxd ww 600 Ω 3W 10%	13606	242E-2025
R11	R: fxd ww 2K 3W 10%	13606	
R12	R: fxd comp 15K $\frac{1}{2}$ W 10%	01121	
R13	R: fxd comp 750 Ω $\frac{1}{2}$ W 10%	01121	
R14	R: fxd mf 634 Ω $\frac{1}{2}$ W 1%	07716	CECTO
R15	R: fxd comp 62 Ω $\frac{1}{2}$ W 10%	01121	
R16	R: fxd comp sel val $\frac{1}{2}$ W 10%	01121	
R17	R: fxd comp 62 Ω $\frac{1}{2}$ W 10%	01121	
Q1 - 2	Transistors: PNP	24433	2N1375

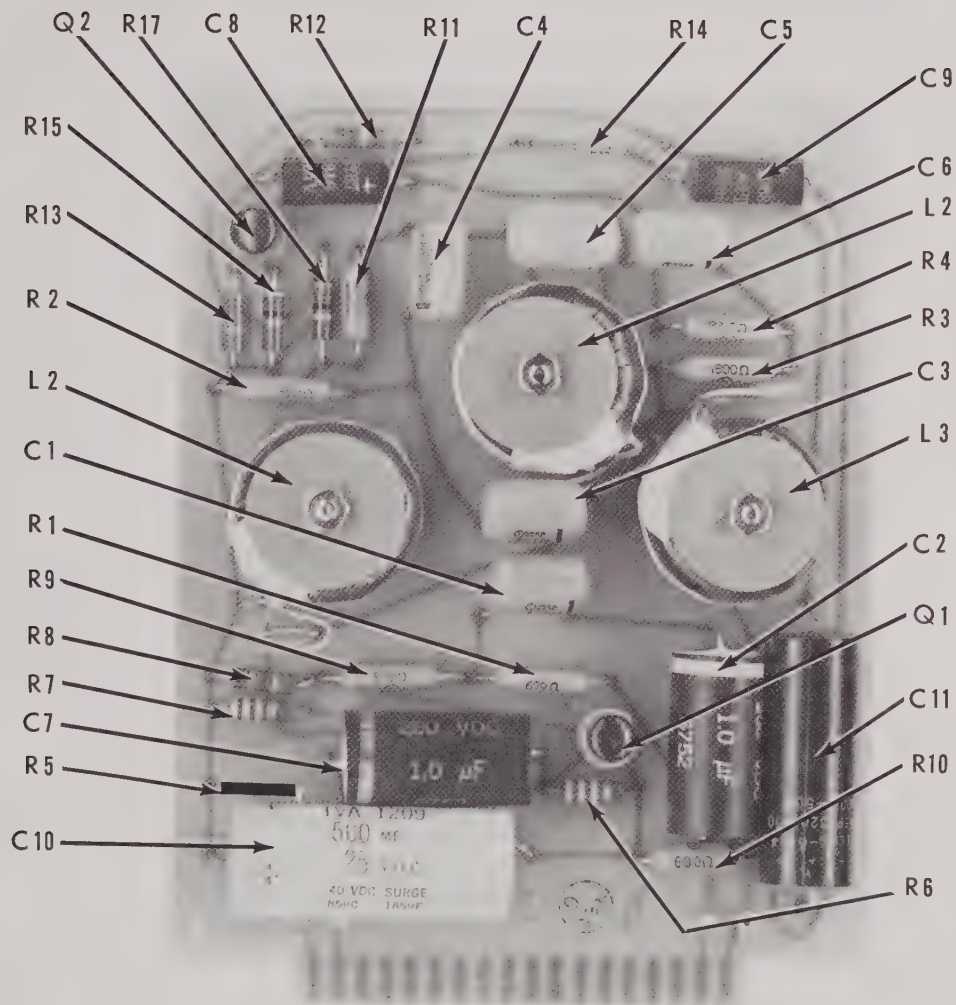


Figure 6-7 Component Location Card 4

**INSTRUCTION MANUAL
FOR
MODEL TTS 66-3
RINGER TEST UNIT**



NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 — CONCORD, N. H. 03301

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SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 DESCRIPTION. The TTS 66-3 Ringer Test Unit contains controls to manually switch one of fifteen different ringing frequencies from an external ringing generator to a telephone. The TTS 66-3A is available to provide the switching and controls for a single ringing frequency. A polarity switch permits ringing to ground on either side of the line or metallic. A LINE LOAD key inserts loop and leak resistances, subjecting the ringer to simulated line conditions.

1.2 The ringer capacitor breakdown test is performed by applying 500V dc across the telephone set capacitor. A leakage detector circuit checks the results and lights a GOOD or DEF lamp. An OFF HOOK alarm circuit and interlock ensures that the telephone is on hook during this test to avoid damage to the transmitter by the high voltage. The operator is protected from the high voltage by the necessity of operating two switches.

1.3 SPECIFICATIONS

RINGER TEST

a. Switching for up to 15 external

ringing frequencies.

b. RINGING MODE - selection of continuous or timed (approximately 60 interruptions per minute with 50% duty cycle) and selection of Harmonic, Decimonic or Synchromonic ringing frequencies.

c. LINE LOAD - Leak A network and 1200 Ω loop resistance.

d. POLARITY - Ring to ground, tip to ground and metallic.

500 VOLT CAPACITOR BREAKDOWN TEST

a. Lamps indicate GOOD or DEF.

b. Detects up to 40M Ω leakage at 500 $\pm$ 50V dc.

c. Off hook interlock protection.

d. Automatic capacitor discharge.

e. High voltage safety interlock.



Fig. 2-1 Front Panel Controls

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS (See Fig. 2-1).

Name of Control	Ref Desig.	Type of Control	Use or Purpose
IN TEST lamp	DS1	Indicator	Indicates set is prepared for Ringer testing.
OFF HOOK lamp	DS2	Indicator	Indicates that the handset is off hook.
RINGING MODE switches	S1 & S2	Key switches	S1 selects either continuous or timed ringing. S2 selects Harmonic, Decimonic or Synchronic ringing.
RINGING FREQUENCY S3 thru S7		Key switches	Used to select desired ringing frequency.
POLARITY Switch	S8	Key switch	Provides tip to ground, ring to ground and metallic ringing.
LINE LOAD Switch	S9	Key switch	Inserts loop and leak network.
RINGER CAPACITANCE BREAKDOWN switch	S10	Key switch	Used in conjunction with HV INTERLOCK switch to supply 500V dc to L1 and L2 terminals.
RINGER CAPACITANCE BREAKDOWN	DS3 & DS4	Indicators	Indicates if capacitor has broken down.

2.2 OPERATING INSTRUCTIONS.

measurements or calibration procedures can be performed.

2.3 PRELIMINARY PROCEDURE. Connect -48V dc and ground to the jack on the rear panel observing polarity marked on panel. If the test set contains the optional TTS 66 XPS Power Supply, connect the power cord furnished between the connector and a source of 110-120V ac, 60 Hz. On the TTS 66-C Control Unit, set the POWER switch to ON.

NOTE

The low voltage power supply contained in the TTS 66-C requires a warm-up period of approximately 5 minutes before

- 2.4 a. Connect ringing leads to rear panel as marked.
- b. Set SEQUENCE switch on TTS 66C control unit to RINGER TEST or to Remote Control if foot switch is used.
- c. Connect the telephone set line cord to the L1, L2 and G terminals on the TTS 66C control unit.

2.5 RINGER TEST

- a. If harmonic, decimonic or synchro-

Section 2

Paragraphs 2.5 and 2.6

monic ringing is used, establish the proper condition with the RINGING MODE keys. Ringing is obtained either continuously or timed by the operation of the CONT-TIMED key. The desired ringing polarity, on tip, ring or metallic, should be established by the POLARITY key. The LINE LOAD key introduces or removes a line load condition of 1200Ω and leak A network.

b. The ringing tests are on an audible basis. Operate required RINGING FREQUENCY key to RING L

or RING N/L.

c. At the completion of the ringing tests, operate the RINGER CAPACITANCE BREAKDOWN key to 500V while simultaneously depressing the HV INTERLOCK pushbutton on the TTS 66-C front panel.

2.6 A satisfactory or unsatisfactory condition is indicated by the associated GOOD or DEF lamps. With the above, if a handset is placed off hook, the OFF HOOK lamp will operate, precluding further test until the handset is placed on hook.

SECTION 3

CIRCUIT DESCRIPTION

3.1 GENERAL. The TTS 66-3 Ringer Test Unit provides a means of selecting harmonic, decimonic or synchmonic ringing in fifteen different frequencies, (there are 5 frequencies for each type). These ringing frequencies are generated by an external generator and connected to the rear panel of the TTS 66.

3.2 CIRCUIT OPERATION. (See schematic diagram, Figure 5-1). The ringing frequencies are applied to the TTS 66-3 through plug P8. Key switch S1 selects the type of ringing to be used and key switches S3 to S7 select either a locked or non-locked mode of operation for each frequency. Key switch S2 provides for continuous or timed ringing.

3.3 The Time Cycle Generator on PC board E95035 controls the operation of the INT (interrupt) relay. In the TIMED position of key switch S2, the ringing frequency is applied at a rate of 60 interruptions per minute, to key switch S8. Key switch S8 provides ringing on either tip positive, ring positive or metallic circuits. A loop and leak circuit consisting of R4, R5, R6, R7, C2 and C3 modifies the ringing frequency to subject the

telephone under test to the worst ringing conditions. Key switch S9 determines whether or not this circuit is utilized. When all ringing conditions are established, the ringing frequency is applied through plug P8 to the 66-C control unit and the L1, L2 and G terminals.

3.4 RINGER CAPACITANCE BREAKDOWN CIRCUITS. The battery input to the HV Power Supply in the TTS 66-C is connected through the normally open contacts of the HV INTERLOCK switch in the Control Unit and the normally open contacts of the RINGER CAPACITANCE BREAKDOWN -500V key switch on the TTS 66-3 front panel.

3.5 A time delay circuit, R3, C4 and the HV relay, is provided to ensure that the telephone handset is on hook. If the set is off hook, the OFF HOOK lamp on the front panel will operate. With the telephone set on hook, an additional delay is provided by C1 and R2 and the D relay. This second time delay prevents the initial transients in the high voltage from being applied to the input of the HV Breakdown Detector in the TTS 66-C Control Unit.

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 CALIBRATION. There are no calibration procedures for the TTS 66-3 and TTS 66-3A.

4.2 MAINTENANCE INSTRUCTIONS. In the event of a malfunction in the operation of the set, the following simple checks should be performed before attempting more detailed troubleshooting.

a. Check to see that the power connection on the rear panel is correctly connected to the proper external power source:

1. DC (office battery): 44-52V dc, tip negative, ring or sleeve positive:

or

2. AC (for use only when equipped with TTS 66XPS or PS101R regulated 48V dc power supply): 115V ac 60 Hz.

b. Check that all fuses are installed and are of the specified type and rating.

c. Check that all interconnecting plugs are fully mated with the correct receptacles on the rear panel.

4.3 If the malfunction is not cleared during the previous steps, proceed as follows with POWER switch in the OFF position.

a. Completely remove the affected unit from the console by removing the 4 front panel screws and carefully sliding the unit forward and out. The interconnecting cable will be long enough to allow the unit to be placed on the bench adjacent to the

console without disengaging.

b. To gain access to the plug-in component boards, remove the two screws in the upper corners of the hinged rear chassis plate and allow it to swing down. The cards should be removed with the extractor key, pulling straight back until the guides are cleared.

c. Perform a visual inspection of the unit, looking for broken or shorted wires, damaged components and other obvious faults.

d. Check that all plug-in boards are in their correct locations and fully engaged.

e. Check that all plug-in components (including lamps) are fully engaged in their respective sockets.

f. Check operation of panel switches, noting that they operate freely. Visually inspect contacts to ensure positive electrical connections. If required, clean contacts with a good contact cleaner.

4.4 DC POWER DISTRIBUTION

a. Unless otherwise indicated, all voltages are referred to "ground". Connections to ground can always be made to either pin #1 on all interconnecting plugs and sockets or pin A of the plug-in component cards.

b. With POWER switch set to ON, select the desired test and measure the appropriate dc voltages in accordance with the following table.

TABLE 4-1

TEST SELECTED	CONTROL OPERATED	-44 to -52V dc Card or Plug	Pin #
RINGER	NONE	P-8	2
RINGER	HV INTERLOCK	P-8	3
4.5 RINGER TEST UNIT (TTS 66-3) OPER- ATIONAL CHECK		23	VOM between the L1 and L2 terminals (L2 is positive terminal).
a. Set the TEST SEQUENCE switch to RINGER, polarity switch to MET.			c. Simultaneously depress the HV IN- TERLOCK and operate the RINGER CA- PACITANCE BREAKDOWN switch. The meter should indicate 500 ± 50 V dc.
b. To check the RINGER CAPACITANCE BREAKDOWN test voltage connect a			

SECTION 5

SCHEMATIC DIAGRAMS

5.1 INTRODUCTION. The following pages contain the schematic diagrams for the TTS 66-3 and TTS 66-3A Ringer Test Unit. Wherever possible, all the information is contained on one diagram, however, because of limitation in printing, some of the individual printed circuit boards are illustrated on separate sheets.

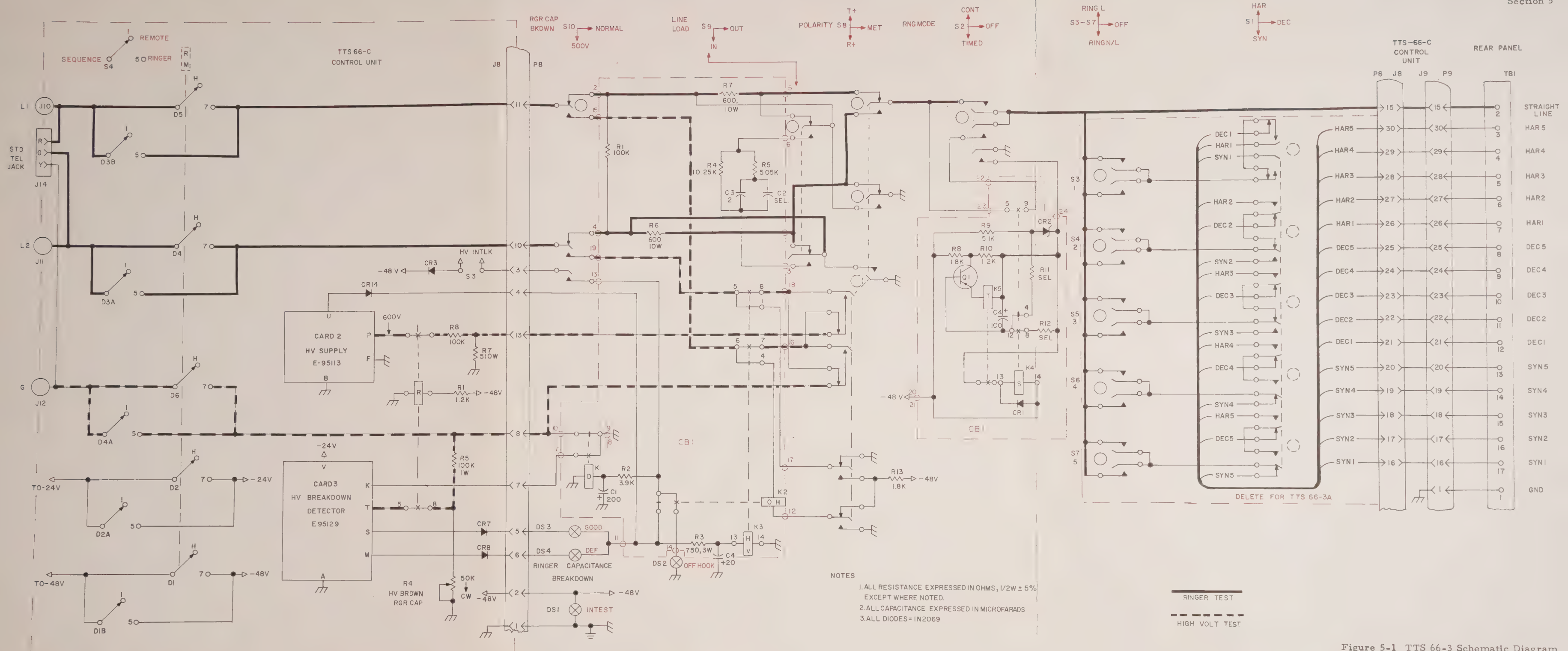


Figure 5-1 TTS 66-3 Schematic Diagram

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following page contains the parts list for the Model TTS 66-3 and TTS 66-3A.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of these numbers and their respective manufacturers is given below.

CODE NO .	MANUFACTURER
01121	Allen Bradley
04221	Aemco
07716	IRC
09653	IEI
12065	Transitron
13606	Sprague
17803	Fairchild
72663	General Control
78277	Sigma
78957	Stromberg-Carlson
80368	Sylvania

6.3 Abbreviations used in the parts list:

fxd - fixed	elect - electrolytic
sel val - selected value	comp - composition
ppr - paper	ww - wirewound
mtl flm - metal film	C - capacitor
R - resistor	S - switches

Section 6

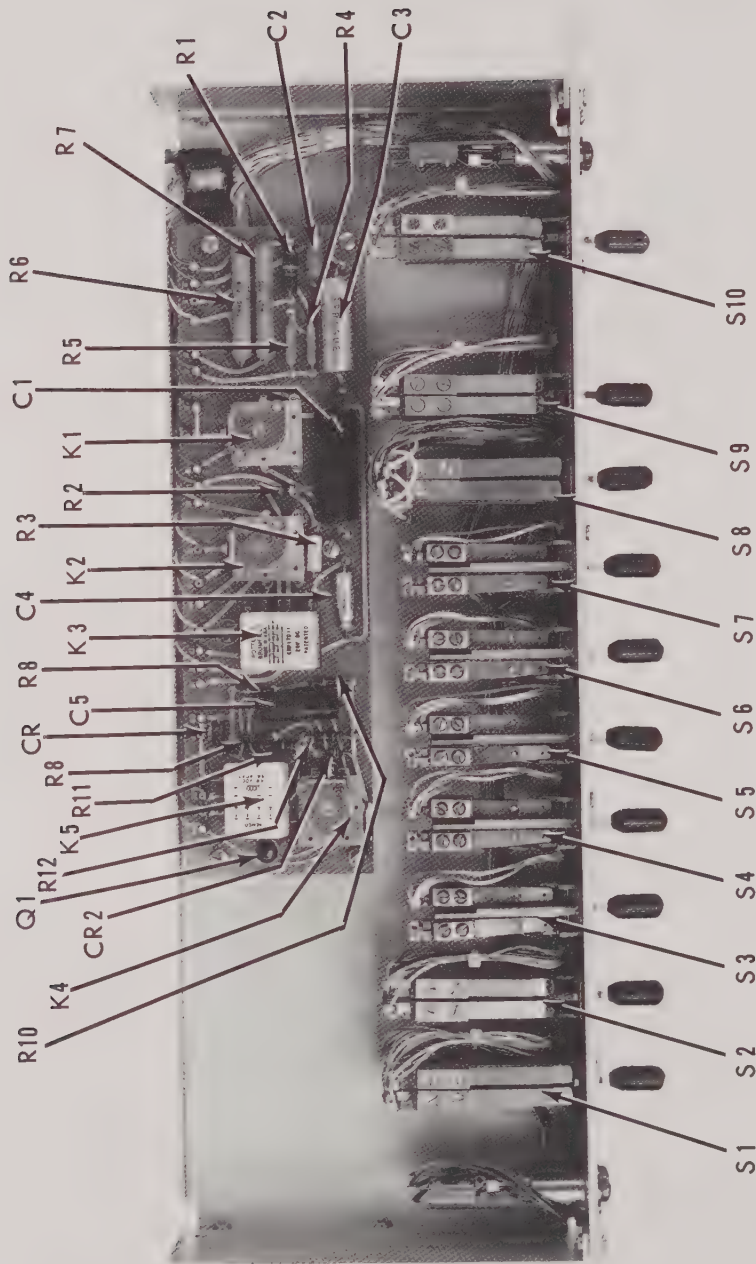


Figure 6-1 Component Location

ELECTRONIC PARTS LIST

CB1

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Numbers
C1	C: fxd elect 200 μ F 50V	13606	FPA-200-J0
C2	C: sel val nominal 0.15 μ F	13606	225P
C3	C: fxd ppr 2 μ F 150V	13606	121P
C4	C: fxd elect 100 μ F 20V	09653	APD-095
R1	R: fxd comp 100K $\pm$ 10% 1W	01121	
R2	R: fxd comp 3.9K $\pm$ 10% 1W	01121	
R3	R: fxd ww 1.2K $\pm$ 5% 3W	13606	242E1225
R4	R: fxd mtl flm 10250 Ω $\pm$ 1% $\frac{1}{2}$ W	07716	CECTO
R5	R: fxd mtl flm 5050 Ω $\pm$ 1% $\frac{1}{2}$ W	07716	CECTO
R6 and R7	R: fxd mtl flm 600 Ω $\pm$ 1% 10W	07716	CECTO
R8	R: fxd comp 1.8K $\pm$ 5% 1W	01121	
R9	R: fxd comp 5.1K $\pm$ 5% $\frac{1}{2}$ W	01121	
R10	R: fxd comp 1.2K $\pm$ 5% $\frac{1}{2}$ W	01121	
R11 and R12	R: sel val		
CR1	Diode	80368	1N2069
CR2	Diode: zener	12065	1N769
Q1	Transistor: PNP	17803	2N4354
K1 and K2	Relays	78277	65FP1A
K3	Relay: 48V coil	04221	156-4023
K4	Relay	78277	65FP1A
K5	Relay: 48V coil	04221	156-4023

Main Assembly

DS1 thru DS4	Lamps: 60V	80368	60A
S1	S: key (blk handle)	72663	MCT4-T1-1B-U-1B
S2	S: key (red handle)	72663	MCT4-T5-2C-2C-0-0
S3 thru S7	S: key (blk handle)	72663	MCT4-T2-C-C-C-C
S8	S: key (blk handle)	72663	MCT4-T1-1B-U-1B
S9	S: key (blk handle)	78957	170E
S10	S: key (red handle)	72663	MCT4-T5-26-26-0-0
R13	R: fxd comp 1.8K $\pm$ 5% 1W	01121	

The following parts are deleted on the TTS 66-3A: S1, S3 thru S7.

TTS 66

CHANGE INFORMATION

The following changes have been made on some of the TTS 66 modules.

TTS 66C:

On pc board E95112 - R1 changed to 1.8K

TTS 66-1A:

On CB1 - R13 changed to 6.2K
- R15 changed to 6.2K

On CB2 - R27 changed to 6.2K
- C5 changed to 50 μ F

TTS 66-3

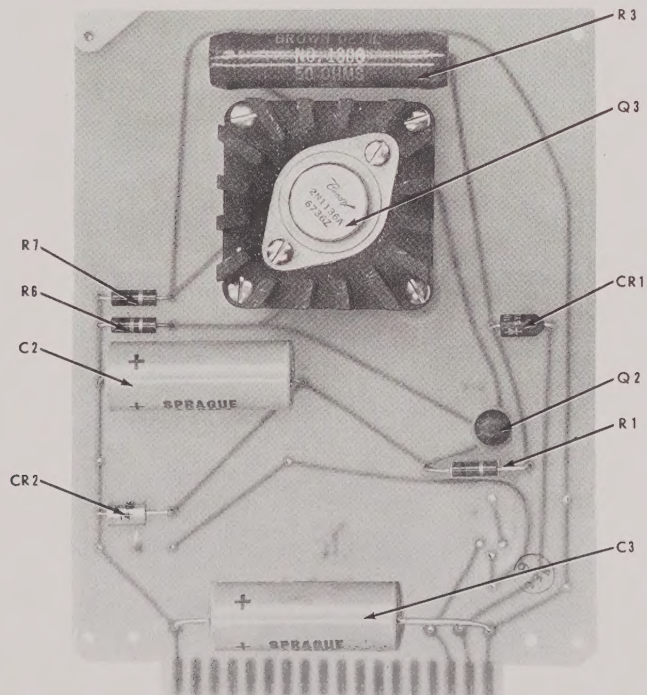
On CB1 - R2 changed to 6.2K
- R13 changed to 6.2K

TTS 66-C

Change Information

On pc card E95112:

Add C3, 250 μ F 50V (as shown in the illustration below).



7/20/69

